MILITARY

SIGNALS

LAND ★ SEA ★ AIR

) NAVY DAY, OCTOBER 27th . . . . AND THE NAVY DEPARTMENT'S 150th YEAR

IN THIS ISSUE

NAVY
ELECTRONICS
LAB

NAVY
)MMUNICATIONS
TRAINING

COAST GUARD
)MMUNICATIONS

MARINES'
CODETALKERS

NAVAL
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CENTER

SEPTEMBER-
OCTOBER
1948

JOHN L. SULLIVAN
Secretary of the Navy

V. 3
Sept 1948 -
Aug 1949

*SINGLE SIDEBAND SUPPRESSED CARRIER

THE TREND . . . is definitely toward single-sideband operation. Advantages are obvious. Elimination of a continuously running carrier saves power and reduces interference. In fact, a signal is put on the air only when something is said.

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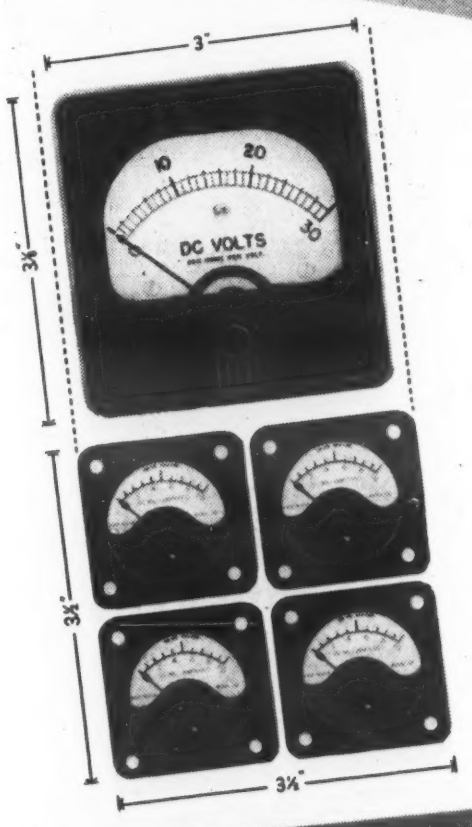

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SIGNALS
LAND ★ SEA ★ AIR

Journal of the Armed Forces Communications Association — Dedicated to Military Preparedness

VOLUME 3 SEPTEMBER-OCTOBER, 1948 NUMBER 1

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Becoming a separate service in the military establishment of the U. S. in 1798, the Navy acquired in the same year its first secretary. Benjamin Stoddert was a merchant shipowner and had been secretary to the Board of War, a predecessor of the War Department. Bringing this experience, and a high intelligence, to the newly formed Navy Department, Stoddert engendered the real start of developing the U. S. Navy. The Navy, therefore, has good cause to celebrate the beginning of the auspicious administration of its first secretary. This year is the sesqui-centennial of the department's creation and Benjamin Stoddert's appointment.

To mark this important date, and because this Navy Day is the first since the Navy began participation in AFCA activities, this issue of SIGNALS is dedicated to Navy and adjunct communications. In addition to these commemorative purposes, the issue serves somewhat to acquaint the other services with the naval side of military communications—those of the Navy, Marines, and Coast Guard, a great team in the defense of this country.

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THE COVER

Secretary of the Navy John L. Sullivan scans the Navy's future. See editorial, page 12.

NAVY ELECTRONICS LABORATORY WORK

The Navy Electronics Labarotory s an organization of civilian scien- ists and engineers, aided by naval fficers and men, engaged in re- earch, development and systems lanning in the field of electronics. t is under the technical control of he Bureau of Ships of the Depart- nent of the Navy and its work pro- ram is largely determined by the cientific and technical problems as- igned by the Bureau.

It is the function of NEL to serve he Chief of the Bureau of Ships and hus the Department of the Navy in he design, procurement, testing and nstallation planning of Fleet elec- ronic equipment. This is a broad esponsibility. It requires work in heoretical science and basic re- earch; in applied science from de- ign through production engineering; nd in training for equipment opera- ion and maintenance.

NEL is located at San Diego, California. Its main group of buildings is situated high on Point Loma, 400 feet above one of the busiest harbors on the Pacific Coast. A second group of buildings is on the waterfront adjacent to the channel leading into San Diego harbor. Here are located piers for mooring the laboratory's surface ships and experimental submarine which carry the work of the laboratory in sonar and related projects out to and under the sea.

NEL is the result of many years of planning by naval scientists. Long before the outbreak of World War II, the Navy Department had realized a need for an electronics research laboratory so located that it would be easily accessible to Fleet units, with meteorological and oceanographic conditions favorable for the study of electromagnetic-wave and sound-wave propagation. Thus, in 1940, the Navy established a radio and sound research laboratory in the San Diego area. Throughout World War II, the U. S. Navy Radio and Sound Laboratory, as it was designated, concentrated its efforts on research and development in radar and radio communication. The work of

The model carrier pictured above was built to scale at the Navy Electronics Laboratory for studies of antenna design. It rests on a miniature "ocean" of hardware cloth at the laboratory's Model Range.

The model range was set up to study the causes and possible reduction of ship communications antenna directivity. The model studies were of immeasurable help during the war when full-sized ships were not available for detailed study.

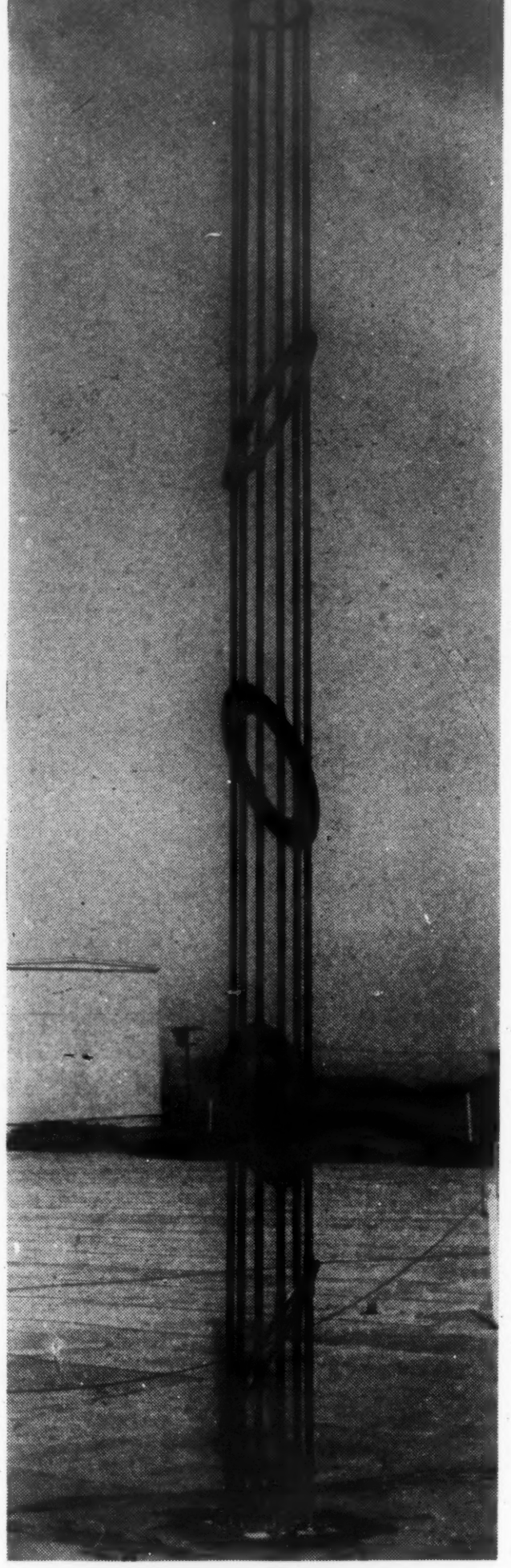
this laboratory was coordinated with that of the University of California, Division of War Research, which was for the most part housed within the Laboratory. When the university group discontinued its wartime studies along with other such university organizations over the country, the essential work of UCDWR was assumed by the Navy organization which , in keeping with its increased responsibilities, was designated the U. S. Navy Electronics Laboratory.

NEL's assignments are broad; they indicate a need for extensive work in a number of fields. They call for a long-term program of systems engineering—the study and improvement of all the electronic equipments on single ships and on classes of ships. They call for a continuation of the wartime job of developing, modifying and testing radio and radar communications equipment developed by this and other laboratories. They call for an extended program of propagation studies—studies of the behavior of electromagnetic waves in the atmosphere and of sound in the ocean. They call for the continued development and improvement of sonar gear and sonar devices, as well as of training aids. They also call for assistance to local training activities, to Fleet units, and to other Navy research activities.

The organization of the Navy Electronics Laboratory is such that the research and development program is directed and carried out by civilian scientists with the aid of naval personnel. The director is a naval officer who is directly responsible to the Bureau of Ships for the laboratory's program. The present incumbent of this position is Captain Rawson Bennett, II. The progress of the work is directed by a civilian scientist aided by a consulting staff. There are seven departments, five of which carry the burden of the scientific and technical work—the remaining two provide supply and administrative services.

Broad Band Antenna

One of the major develoments of NEL, Systems Engineering, has the job of transforming what might be called a "jungle" of "dishes," "bedsprings," "whips," and "parabolas," into a coordinated system of highly efficient radiating and receiving structures ashore and afloat. As the name of the department indicates, it is charged with working out complete communications systems type plans. The staff of this department is seeking to determine what happens to a



Experimental self-supporting broadband antenna.

burst of energy as it leaves the plate of a power amplifier tube in a transmitter, travels along a transmission line to the antenna, journeys through space to another antenna, and finally, arrives at an operator's headphones.

It has only been in the past few years that comprehensive information has been obtained about shipboard communications and radiating systems. During the war there was little time for extended research in antenna behavior aboard ship. The result was that without long-range advanced planning, antennas of all types, sizes, and configurations were mounted on Navy ships.

NEL began work on the problem of reducing the number of antennas aboard ship and of making the remainder perform more efficiently. The most promising approach seemed to hinge on the development of a broad-band radiator that would operate efficiently over a relatively wide band of frequencies and handle the outputs of several high-power Navy transmitters. By definition, this meant an antenna closely matched to associated power amplifiers over a band of frequencies. Since antennas are not located next to their respective transmitters, it also meant the wider use of low-loss low-impedance transmission line.

The problem at NEL was split into several lines of research, each to progress simultaneously, yet so integrated as to produce a complete antenna-system type plan. One group began studies of the low-impedance transmission line; another began experiments with potential broadband structures; another studied with models, the behavior of regularly installed and experimental antenna types aboard ship.

Several types of coaxial line had been developed during the war and, after study of these types, one with a 50-ohm characteristic impedance was selected. This was RG-18/U coaxial cable with a maximum power-handling capacity of 500 watts. This capacity limitation demanded that certain operating limits be observed. These limits, the placing on the cable of standing-wave ratios of no greater than 4 to 1 at the highest operating frequency nor 15.6 to 1 at the lowest, were liberal enough to provide in the cable, a transmission line for use with experimental broadband antennas.

From theoretical computations it was determined that the over-all length of this radiator should not be shorter than 0.25 wavelength at the lowest frequency nor longer than 0.65 wavelength at the highest. Further, since radiated energy on it would be vertically polarized, the proposed broadband structure should be a vertical one, self-supporting, and of a bulk easily accommodated aboard ship.

The first antenna constructed at the Navy Electronics Laboratory to these specifications was a dural tube 20 feet 7 inches in length, and 7 inches in diameter, with its lower extremity tapered over a 7-inch length to a diameter of three inches. It was self-suporting in a Micarta "christmas-tree" stand. Its 0.25 wavelength resonance point was calculated to be 9 megacycles and it was ex-

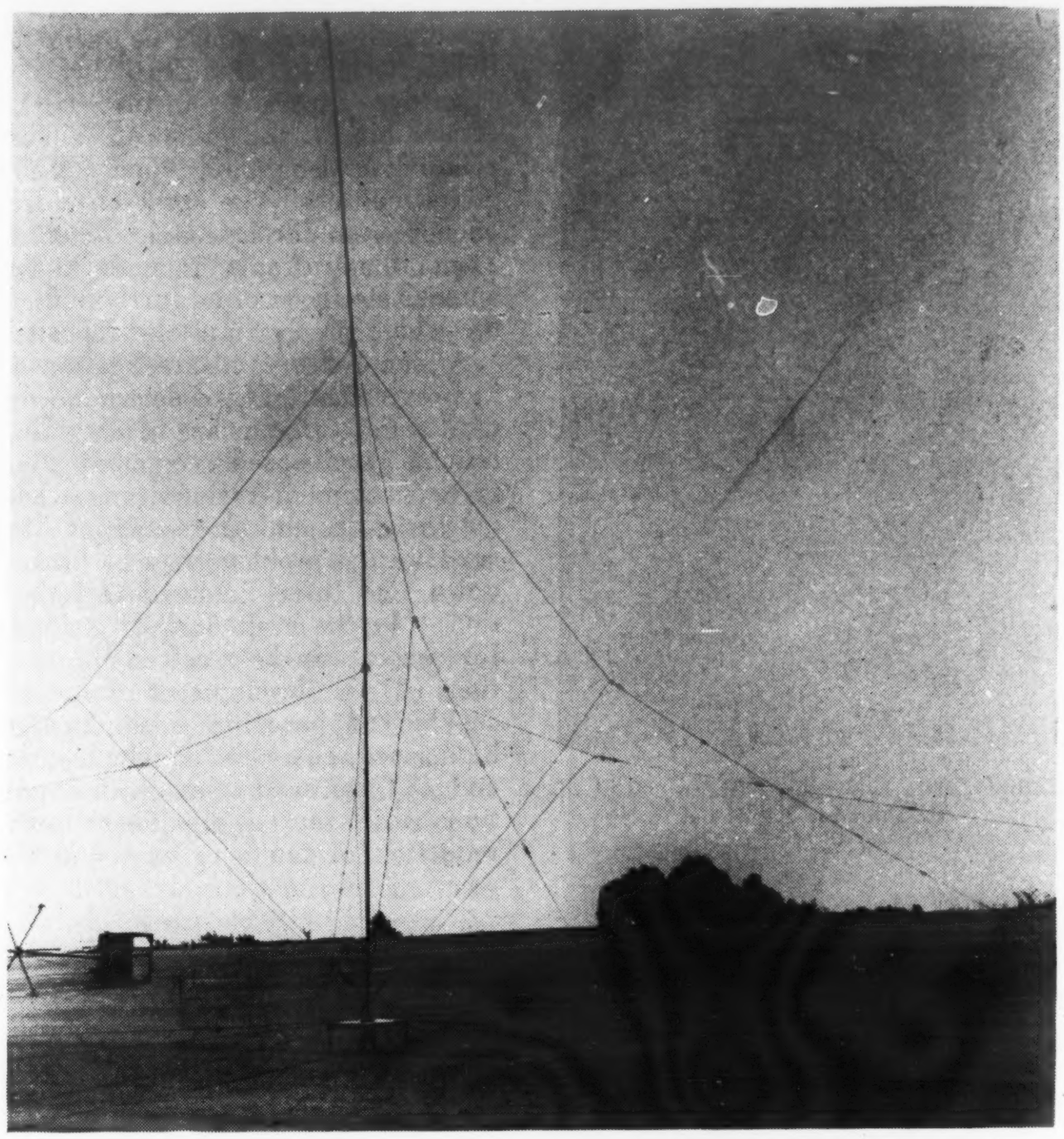
ected that it would operate at fre-
uencies up to and including 18
egacycles. For convenience it was
esignated as the "thick monopole"
nd was tested through a fixed-tune
atching network and a calibrated
easuring cable over a simulated
round plane.

Measurements were taken over the
ntire 2- to 27-megacycle range to
low for any uncorrected error in
lculations. Contrary to expecta-
ons, desired broadband character-
tics were not obtained over the 9-
18- megacycle span, but rather at
equencies lying between 11 and 22
egacycles. The standing-wave ratio
er this span was 3 to 1, well within
e limits prescribed by the use of
G-18/U cable. Later tests, made
oard the laboratory's experimen-
l ship, a PCE (R), and a CVE
rrier, produced susbstantially sim-
r results from 11 to 22 megacycles.

Progress Made

A start had been made. The next
ep was to obtain a radiator that
ould work over the rest of the fre-
ency spectrum. Expanding the
ick monopole to cover the lower
ans was out of the question. Its
lk would become prohibitively
rge, and the large cross-section
cessary would be easily toppled by
nd currents. Experiments with a
ge-type antenna having the same
er-all physical characteristics of the
onopole proved the feasibility of
s type of structure in which wires,
itably placed, would give the effect
a solid structure. The next step
s to determine the optimum cage
sign of a broadband structure and
ll stay within reasonable physical
nits.

The whip antenna which the Navy
es up along the edge of the flight
ck on a carrier looked promising,
it was reproduced at NEL and the
ys themselves were made an inte-
l part of the radiating surface. As
nstructed, this antenna was de-
ned as a quarter-wave radiator at
megacycles. When it was tested
er the simulated ground plane, and
er aboard ship, standing-wave ra-
s of 5 to 1 over the 5- to 27-
gacycle range were observed. Be-
5 megacycles the SWR increased
ond the limits imposed by the
le and above 10 megacycles mul-
e lobe splitting made this struc-
e unsuitable. Scaling down the
ensions of this type of structure
obtain a higher-frequency, quar-
wave resonance point eliminated



Experimental guyed-whip broadband antenna.

the multiple lobes and left only the 2- to 5- megacycle range to be covered.

With the addition of a matching network, the guyed-whip structure, as it was designated, was made to work down to 3 megacycles, but that was as far as it would go efficiently. Thus, a third type of structure was sought. It was found in a bent sleeve type, in which a thin wire is extended outward from the uppermost point of a grounded mast and fed by a coaxial line bonded to the mast throughout its length. Tests by this type, both ashore and afloat, indicated that it would meet specifications. An SWR of 5 to 1 over the 2- to 6- megacycle range was observed.

The Model Range

In model studies of antenna design, structures are tested above a simulated ground plane. This plane is a miniature "ocean" made of hardware cloth placed on a flat surface in the form of a circle 160 feet in diameter. The edge of the circle is irregularly cut to reduce the possibility of systematic production of standing waves at the boundary. On, over, and around this field is the NEL Model Range.

The model range was set up originally in August 1944 to study the causes and possible reduction of ship communications antenna directivity. As its name indicates, measurements are taken with models instead of real ships. The frequencies used for model measurement are established by the well-known principle of similitude which can be most conveniently satisfied by scaling model dimensions, resistivity, and wave length by the same factor. The model studies were of immeasurable help in investigating the properties of shipboard antennas during the war when full-size ships were not available for detailed study. So successful has this work been that the model range is still expanding and more and more classes and types of ships have been modeled.

Much of the information gathered on the behavior of shipboard antenna problems is directly applicable to Navy shore stations. The guyed-whip antenna, for example, in an expanded version, is now being tested experimentally at the Navy's aircraft

Captain Alvin L. Becker, Assistant Chief of BU Ships for Electronics.

shore station at North Island in San Diego Bay. Except for point-to-point applications where directivity is desirable, shore-station antennas for broadcast work must be as nondirectional as those aboard ship. Another type of shore-station antenna, one designed to work on very low frequencies around 15 kilocycles, is being investigated at NEL. The principle of similitude is being used in this case as well. An 8-mile square area at the proposed transmitting site has been faithfully modeled at 1/1000 scale out of concrete and coke to preserve the correct ground conductivity scalar relationship. Cable-slung antenna arrays have been constructed with the same painstaking detail that is put into the modeling of the model ships in tests on higher frequencies.

New Research Instruments

Several new instruments to aid research in antennas and other communications elements have been developed at NEL. In addition to the pneumatic polar plotter, a remotely synchronized plotter for linking measuring sites ashore with ships turning tight circles at sea has been constructed. Another instrument, prototype models of which are now in production, is a r-f impedance meter. This meter replaces the conventional r-f bridge and signal generator in determining the impedance and standing-wave ratio of antennas or other transmitter and receiver elements. Its most desirable feature is the ease and speed with which it may be operated. Bridge techniques require bulky and expensive apparatus, involve tricky computations, and take an almost prohibitive length of time. Many hours may easily be spent on a frequency run for a single antenna. Then, if any change is made in the antenna itself, or in its surroundings, the whole process must be repeated.

A comprehensive investigation is in progress at NEL to determine the most satisfactory means of obtaining reliable high-speed communication between ships at various ranges and between ships and shore stations. The fundamental problem may be broken down into three fields of investigation; (1) the evaluation of methods for presenting the received information, (2) the development of systems capable of handling a number of high-speed channels simultaneously, and (3) the evaluation of all conditions which may be significant to the reduction of faults or errors in the received information.

Reducing Human Factor

The human factor in a system of high-speed communication must be reduced to the bare minimum if faults and errors of commission and omission are to be minimized. Personnel contributions should be limited to the operations of assembling the information to be transmitted, distributing the information as received, and maintaining the equipment in the system. The operations of transmitting the intelligence and recording the information as received should be automatic. These conditions point to the use of facsimile or of some sort of radio-teletypewriter system. An evaluation of the various means of transmitting information and of transcribing the received information into printed form is in progress.

Propagation Study

A number of alternative methods for transmitting and receiving high-speed intelligence are under development. New methods using pulse technique are being developed along with adaptations of the older pulse-sampling systems. Systems using two-tone keying with both frequency modulation and amplitude modulation are being compared in performance with the more or less standard system of frequency-shift telegraphy.

In any system of high-speed automatic communication the controlling of all factors which may lead to errors or faulty transmission is of great importance. The laboratory is proceeding in a comprehensive investigation of all factors, both in regard to equipment and in regard to propagation between stations, which may be of significance in determining the error count. Optimum working frequencies are being determined for varying ranges between ships in terms of propagation conditions and the limitations of shipboard antenna installations.

Propagation of the radio wave

Navy Electronics Laboratory, San Diego, on Point Loma 400 feet above harbor.

from the transmitting to the receiving antenna is a factor beyond the control of the design engineers. Hence information in as complete a form as possible concerning both ionospheric and tropospheric propagation must be made available to the engineers for their use in systems development. Investigation into both fields of propagation is in progress at NEL. The study of tropospheric propagation has been in progress for several years, and the study of oblique-incidence ionospheric propagation was initiated in the summer of 1947. A brief discussion of the work being done in both fields is given in the sections which follow.

It has long been known that the use of diversity reception was an important factor in the reduction of errors in high-speed automatic transmission. The conventional diversity system employs two or more antennas spaced a considerable distance from each other. Such a system is obviously impracticable for use aboard ship. Efforts at the laboratory have therefore been devoted to the problem of evaluating diversity systems which do not require extensive antenna installations. Two of the systems under investigation are sideband diversity and polarization diversity. Brief discussions of the progress to date in these fields has been included in later paragraphs.

Ionospheric Studies

An ionosphere study is in progress as a joint experiment of the Navy Electronics Laboratory and the Central Radio Propagation Laboratory (CRPL) of the National Bureau of Standards. The transmitting station (WWSV) is operated by CRPL at Sterling, Virginia, and the receiving equipment is operated by NEL at the Point Loma laboratory. Station WWSV operates with a peak power input of approximately 600 kilowatts on 13.66 megacycles, sending 40-microsecond pulses with a repetition rate of 25 per second. The transmitter feeds a rhombic antenna with a gain of 14 db in the direction of San Diego.

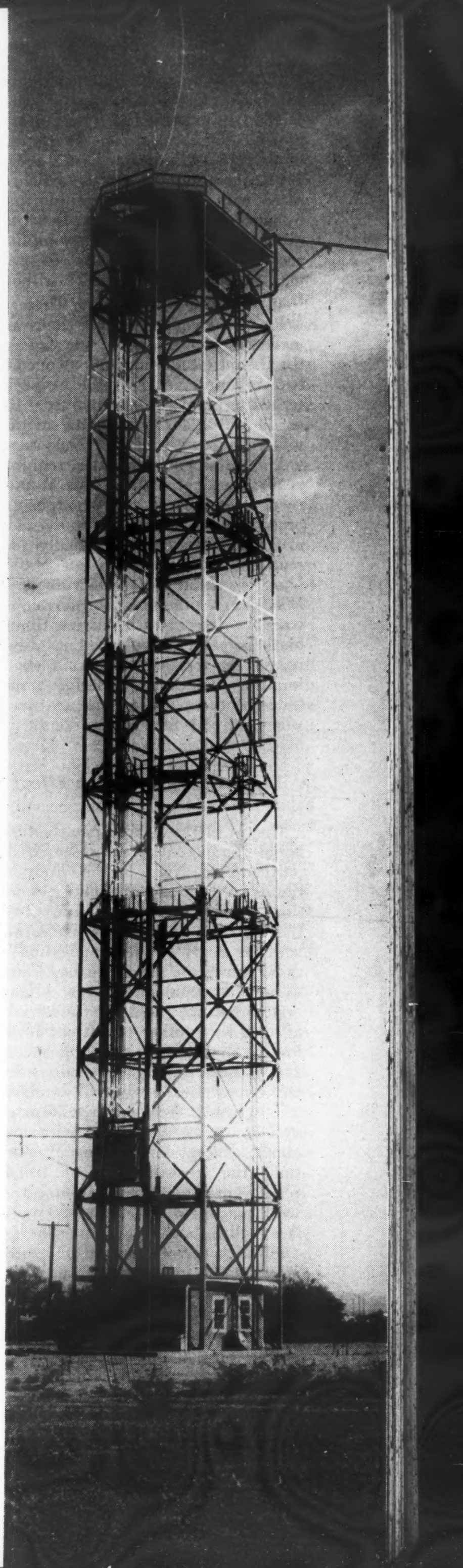
Oscillographic observation of the arriving signal is made by NEL. Three forms of data are taken: (1) photographic records of the pulse arrival times and of the structure of the arriving pulse train; (2) records of the hourly variation of pulse signal strength and of the relative amplitudes of the pulse groups in the train; and (3) records of the pulse strength variations as compared to the fluctuations of the standard frequency c-w signal on 15 megacycles transmitted by WWV. (The WWV transmitter is located at Beltsville, Maryland, about 30 miles distant from the pulse transmitter at Sterling, Virginia.)

Facilities are under construction to permit measurement of the directions of arrival of the various groups in the pulse train and to permit observation of polarization of the components of the arriving signal.

The use of pulse techniques in this study permits time resolution of signals arriving by different paths. The path length taken by the signal varies widely as a function of the number of hops taken in transit and as a function of the heights of the reflecting layers. Because the arriving signals may be separated on a time scale, it becomes convenient to resolve them further on a basis of direction of arrival or by virtue of differing polarization. It is hoped that by resolving the signal in terms of transit time, polarization, and direction of arrival it will be to obtain sufficient information from the experiment to: (1) permit construction of an artificial ionosphere for the over-all testing of communication systems employing the ionosphere as the link between the transmitter and receiver; (2) demonstrate ionosphere limitations on communication speed and to indicate methods by which communication speed can be increased; (3) demonstrate whether reduction of fading is possible by means of mode selection (direction of arrival, time of arrival, or wave polarization resolution); (4) indicate criteria for the design of diversity reception equipment; (5) correlate observed vertical-incidence virtual-height measurements with virtual heights deduced from oblique-incidence time delays; (6) show the importance of scatter echoes in long-distance transmission; and (7) demonstrate the possible utility of pulse transmission for communication at frequencies normally reflected by the ionosphere.

Experimental Technique

The 13.66-megacycle pulses are received on either or both of two antennas, one a half-wave doublet whose main lobe is directed toward Sterling, and the other a vertical half-wave sleeve antenna. The 13.66-megacycle signal is fed through a frequency converter whose output frequency is 1.9 megacycles. The signal from the converter is then fed



to the 1.9 megacycle input of a Navy DAS-4 Loran receiver-indicator, in which the signal is presented on a 5CP11 cathode-ray tube on several possible time scales. The sweep rate of the DAS-4 indicator is 25 cycles per second and is exactly synchronized with the pulse repetition rate by means of a crystal clock. Synchronization to one part in thirty million accuracy is required so that pictures may be taken automatically without frequency correction for drift.

Records of pulse arrival times are made by photographing the face of the DAS-4 oscilloscope about once in two minutes. A Fairchild type A recording camera is employed. Records are made on a 35-mm motion picture film with about 16 exposures a foot. The exposure time required is 1 second at f 5.6. This routine record requires about 720 exposures or 45 feet of film in 24 hours. The arriving pulse train is usually presented by the indicator on a time base of about 4500 microseconds. Pulses are presented on an upper trace; a lower trace carries timing markers only. Supplementary drawings of the arriving pulse train, showing time delays and relative amplitudes of the pulse groups are made when extreme changes warrant.

Model Carrier built for studies of antenna design.

Temperature Inversion Effect

One of the long-term investigations being conducted by the research department of NEL is the study of radio-wave propagation under conditions of temperature inversion. Briefly, the problem is concerned with the study of the propagation of radio waves in the frequency range where the signal intensity at a moderate distance will be materially affected by weather conditions in the lower atmosphere or troposphere. The frequency range normally affected by variations from "standard" atmosphere is from perhaps 50 megacycles to 10,000 megacycles and above. Except under unusual conditions the investigations of tropospheric propagation are concerned with ranges of less than 300 miles. A so-called "standard" atmosphere is one which the air nearest the ground is warmest, most humid, and most dense; above the ground it gets steadily colder, dryer, and thinner. Pressure, temperature, and humidity all decrease regularly with altitude. When radio waves pass through such an atmosphere they are bent slightly downward so that energy is transmitted directly to points somewhat beyond the horizon. This extension under standard conditions is slight enough to be relatively unimportant, and the optical horizon is the limit of radar and v-h-f coverage.

The ground-based inversion is the type which is frequently obtained over a land area at night in a region where there are large variations in ground temperature from day to night. Such a condition is often found in desert areas. The laboratory has established a test station on the Arizona desert near Gila Bend to study propagation under these conditions of index-of-refraction variation. Three 200-foot towers have been installed along a 47-mile transmission path between Gila Bend and Datelan. The tops of the first two towers are within optical view, but the third tower is well below the optical horizon. Elevators for the raising and lowering of transmitters, receivers, and test instruments are located on each of the towers. Supplementary meteorological information is obtained from instruments carried aloft by sounding balloons used by periodic aircraft flights.

The second type of inversion is most commonly found over the ocean and along the seacoast. The existence of this condition along the coast of Southern California is so common as to be considered normal, although the intensity of the condition undergoes wide variations. Propagation with this type of atmospheric condition is studied directly from the Laboratory at Point Loma. A series of propagation tests along a 90-mile path over sea water from Point Loma to San Pedro, California, using frequencies of 52, 100, and 547 megacycles has been reported in detail.[1] These tests are continuing along with

[1]Smyth, J. B., and Trolese, L. G., "Propagation of Radio Waves in the Lower Troposphere," Proceedings I.R.E., vol. 35 no. 11, November 1947.

extensive shore-to-aircraft tests over the sea. Propagation ranges out to several hundred miles using frequencies from 60 megacycles to over 10,000 megacycles are being investigated in these aircraft tests.

Refraction and Height Effect

Several points of general interest may be derived from a brief scanning of the wealth of propagation data being obtained and evaluated by this group. In the first place, both the change in the index of refraction and the height at which the change takes place are effective in determining the scale of the reflection effect. The scale of the meteorological effect in turn determines the lowest frequency which will feel a significant variation in propagation. Stated in another way, for a specified meteorological condition there is a low-frequency cutoff below which no variation in propagation will be apparent. The range of frequencies over which the low-frequency cutoff may vary is from perhaps 25 megacycles to about 300 megacycles. Below 25 megacycles tropospheric conditions of the most favorable nature may be expected to cause but a few db of variation in signal; while above 300 megacycles all frequencies are affected simultaneously by an inversion condition, and a signal variation of 50 db or more is common as inversion conditions change.

For frequencies below 100 megacycles the signal strength at a receiving point below line of sight will seldom equal the free-space value, even under the most favorable of inversion conditions. However, above 300 megacycles the received signal intensity may exceed the free-space value by a large amount, the increase tending to become greater with increasing frequency. In fact, when favorable propagation conditions obtain over an extended path, duct propagation may be said to exist, wherein the received field intensity may fall off as slowly as the inverse square-root of the distance.

Sideband Diversity Reception

Any transmitted radio wave which carries intelligence can be shown to consist of a sinusoidal carrier wave plus a structure of sidebands which actually carry the intelligence. In the case of amplitude modulation, the sidebands are replicas of each other, spaced symmetrically on either side of the carrier, and each carries the same intelligence. The usual demodulation methods operate on both sidebands, recovering the intelligence from their combined effect.

1/12-scale model of an escort carrier's island structure.

For tropospheric propagation, or for ionospheric propagation where multipath effects are not troublesome, this demodulation process is satisfactory, since the carrier and each sideband follow the same path at the receiver in the proper phase to give an undistorted envelope. But trouble results when one sideband takes a different path through the ionosphere than the other, or when the carrier is refracted through the ionosphere in some manner different from one or the other of the sidebands. The resultant out-of-phase combination of the carrier and sidebands at the receiver may cause severe fading and distortion.

The system described below was developed by the development department of NEL for the purpose of studying selective fading of amplitude-modulated tone-telegraph signals, with the intent of providing sideband diversity. In order to do this it is necessary that the sidebands which are generated by the tone modulation of the transmitter be separated and recorded or observed separately.

Frequency Considerations

For purposes of illustrating the method used let us consider the case of any carrier frequency in the range normally tuned by a communication receiver. Let this carrier be amplitude modulated with a 1000-cycle tone. We now have three radio frequencies; namely the carrier, and an upper and lower sideband each separated from the carrier by 1000 cycles. Suppose the receiver which is receiving this signal has an intermediate frequency of 455 kilocycles. If the receiver is properly tuned we will now have one sideband at 454 kilocycles, another at 456 kilocycles, and the carrier at 455 kilocycles. If we now insert another signal at 457 kilocycles and demodulate we will have three audio tones produced, 1000, 2000, and 3000 cycles. The original carrier will be represented by the 2000-cycle tone, the 454-kilocycle sideband will be represented by the 3000-cycle tone and the 456-kilocycle sideband will be represented by the 1000-cycle tone. To select either of the sidebands or the carrier it is necessary merely to provide an audio band-pass filter of the proper frequency. By means of this equipment, independent fading characteristics of either of the sidebands or the carrier can be observed.

The equipment used consisted of an AR-88 receiver, an auxiliary i-f amplifier and a-v-c system with balanced modulator and local oscillator, an audio amplifier and tone filter for each of the tones used, oscilloscope for monitoring each tone, and an Esterline-Angus recording milliammeter for recording the level of each tone.

The standard frequency transmissions from WWV were used as a test signal. Use was made of only the 440-cycle modulation on WWV in the initial tests. As the AR-88 has an intermediate frequency of 455 kilocycles, the local beating oscillator was set at 456.615 kilocycles in order to obtain an audio frequency of 1615 cycles for the carrier, and 1175 and 2055 cycles for the two sidebands produced by the 440-cycle modulation on the WWV carrier.

EDITORIAL

We Americans regard democracy as an established, dominant fact in this world. We believe that small nations should not be throttled or taken over by stronger ones, that civilization implies the right to criticize the government in power, and that it guarantees freedom of speech and of religious observance. We believe in institutions of law and justice which maintain their integrity independent of any administration currently in power. This is what our Declaration of Independence means when it says that governments draw their just powers from the consent of the governed. This is our hope and the hope of the world. This is the will of the American people.

Nothing that happens to the small nations of the world can be without effect upon us. We shall be the poorer for their need; we shall be less secure as they are less secure. We shall probably have peace only in the same measure as they have peace. To guarantee our security through the continued security of Western Europe, to guarantee the peace of the world, we must be strong.

The Navy in its present character and size is primarily a force for peace. It is a tangible, visible, immediately effective instrument for stability in an unsettled world. It is the only adequate means for insuring uninterrupted use of the sea communications which are vital to the existence of the United States. History shows the importance of control of the seas to every great nation whose strength and stability have provided long periods of peace. These lessons are as true today as ever.

In determining what type and size Navy this country needs, the question arises as to whether new developments have not made surface navies obsolete. This is not a new question to the United States Navy, nor is it new throughout the naval history of the world. For twenty-five hundred years new offensive weapons have carried with them the prediction that they would make established techniques of warfare obsolete. In every instance, the development of defensive weapons has offset or neutralized these new factors of offense.

Within this century, explosive large caliber shells, the torpedo, and the submarine have each been heralded as the death knell for surface ships. Armor plate, compartmentation and anti-torpedo defense, and integrated anti-submarine warfare have effectively disproved each claim. At the same time, the weapons themselves have been adapted and developed to the point that they have only strengthened the Navy's control of the seas. The submarine gave us a new dimension in sea warfare, thus adding a new fleet rather than eliminating the surface fleet, and extending the scope of operations to far more effective lengths.

As with the submarine, the airplane, once thought to spell the end of surface navies, has become instead a tremendously powerful arm of the Navy. The Navy operates on, under, and above the seas, and if used to its ultimate potentiality, can control all three spheres. The submarine and the airplane have established even more firmly the Navy's position as a dominant factor in both offensive and defensive warfare.

During the Okinawa invasion it was necessary for the Navy to transport four hundred and fifty thousand men, with ammunition, food, medical supplies, and equipment of all kinds. A fleet of over 1,200 ships was required to do the job, which necessitated their staying in restricted waters close ashore. The covering air support for the landing operation was furnished entirely by Naval and Marine aviators from carriers.

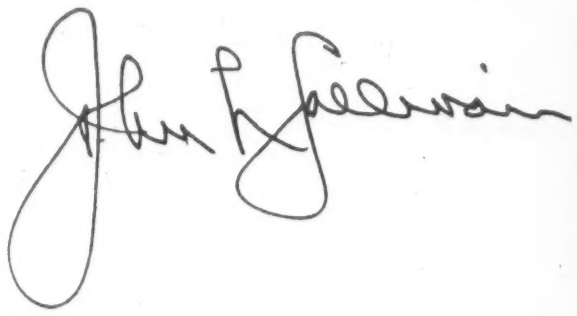
During the three months from March 22 to June 22, 1945, when the Japanese were making their most hysterical and desperate kamikaze attacks on these 1,200 ships, the Fleet that Came to Stay accounted for 7,830 Japanese aircraft, while the enemy did not succeed in sinking one single American carrier, battleship, cruiser or transport. Obviously the defensive techniques of the United States Navy had overcome the advantages claimed for new offensive aircraft techniques.

For those theorists who feel that air transportation can replace water transportation, I mention an analysis that has been made of the problem of moving 100,000 long tons of supplies per month under war conditions from San Francisco to Australia, a relatively common operation during the last war.

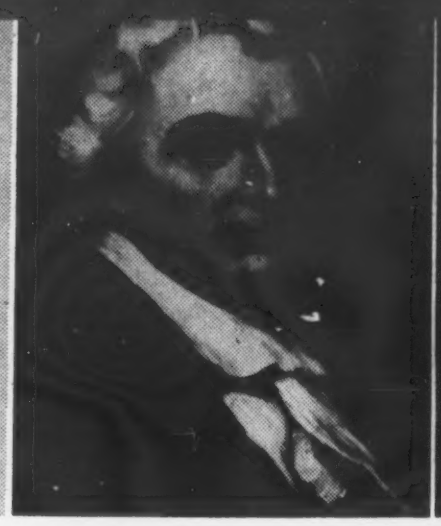
To move this tonnage by seas would require 44 cargo type ships, with 3,200 men to man them, and 165,000 barrels of fuel. Air transportation of this same monthly tonnage would require 10,000 four-engined airplanes of the C-87 type, manned by 120,000 highly trained specialists, and 9,000,000 barrels of gasoline. Even then we could not dispense with ships. A total of 89 tankers would be needed to furnish the gas along the route and at the other end of the line. Of course, the differential here cited will be changed by new developments in aeronautics, but the magnitude of that differential should serve as convincing proof that a Navy strong enough to control the sea lanes will be indispensable throughout our life and that of our children.

The major striking force of a modern Navy is represented by its carrier-borne aviation. A carrier task group can remain at sea for months, refueling and rearming at sea, and even changing the air groups themselves. This capacity has raised to a high point the art of employing force where it will be effective. We are able to establish offshore anywhere in the world air fields completely equipped with machine shops, ammunition dumps, tank farms, warehouses, and accommodations for personnel. Such a task force is virtually as complete as any air base established. It can be moved at will and in any kind of weather. It constitutes an air base that can be made available near enemy territory without negotiation or conquest, and a mobile base that can be employed with secrecy and surprise.

No man who has been associated with the Armed Services and knows intimately the appalling waste and sacrifice of war can ever resign himself to the inevitability of another major conflict. America does not want war, but as a nation we face heavy responsibilities in keeping the peace. These responsibilities have devolved upon us because we champion freedom against tyranny, and individual liberty against the terror of the police state, because we have chosen to defend progressive civilization as embodied in the freedom of man against reversion to barbarism and the rule of force. Our surest security against war lies in preparedness and strength to guarantee peace.



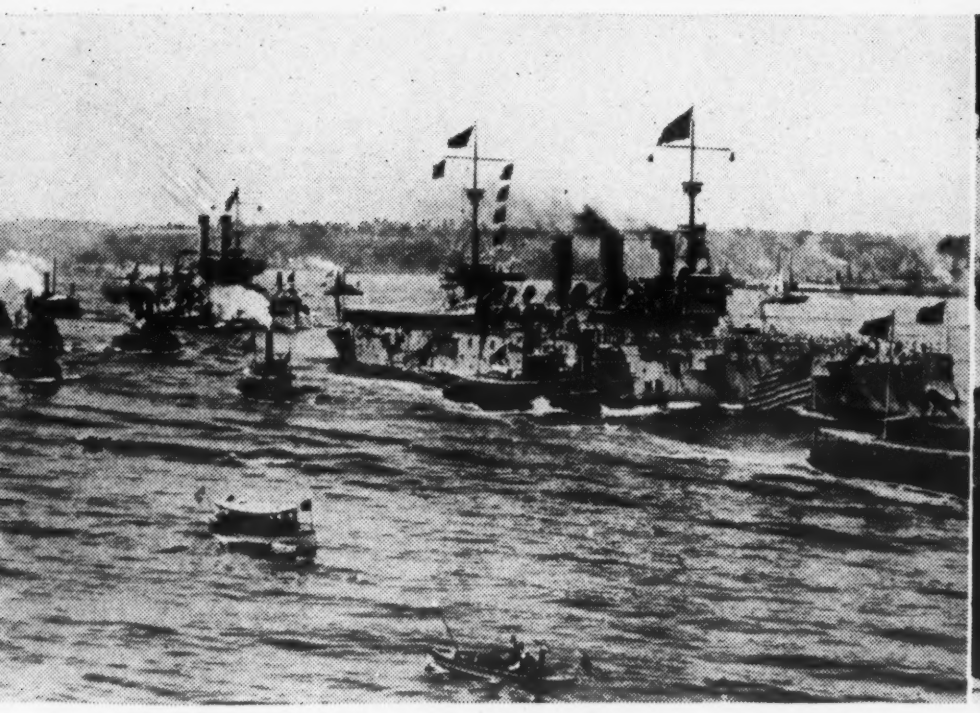
Secretary Of The Navy

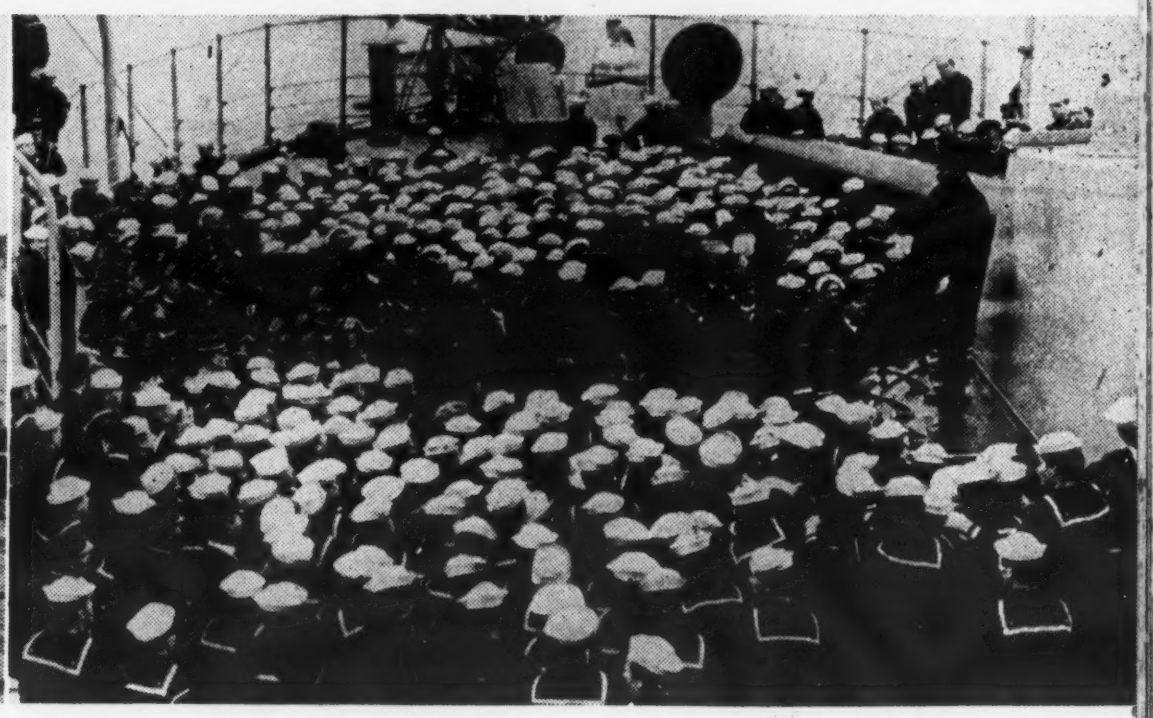


Above: Under the administration of Benjamin Stoddert, first Secretary of the Navy, the United States Navy began its real development. Some of the advancements made in the following 150 years are pictured on these pages.

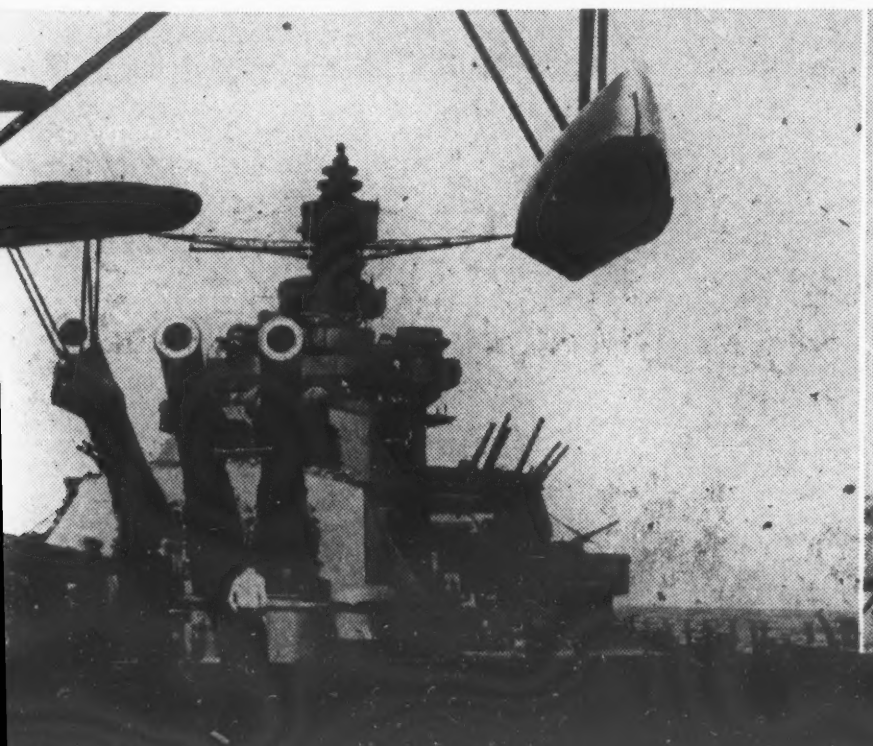
Below: The present Navy Department building in Washington, D. C., and right, the comparatively small structure the department shared with the War Department in the latter part of the last century.

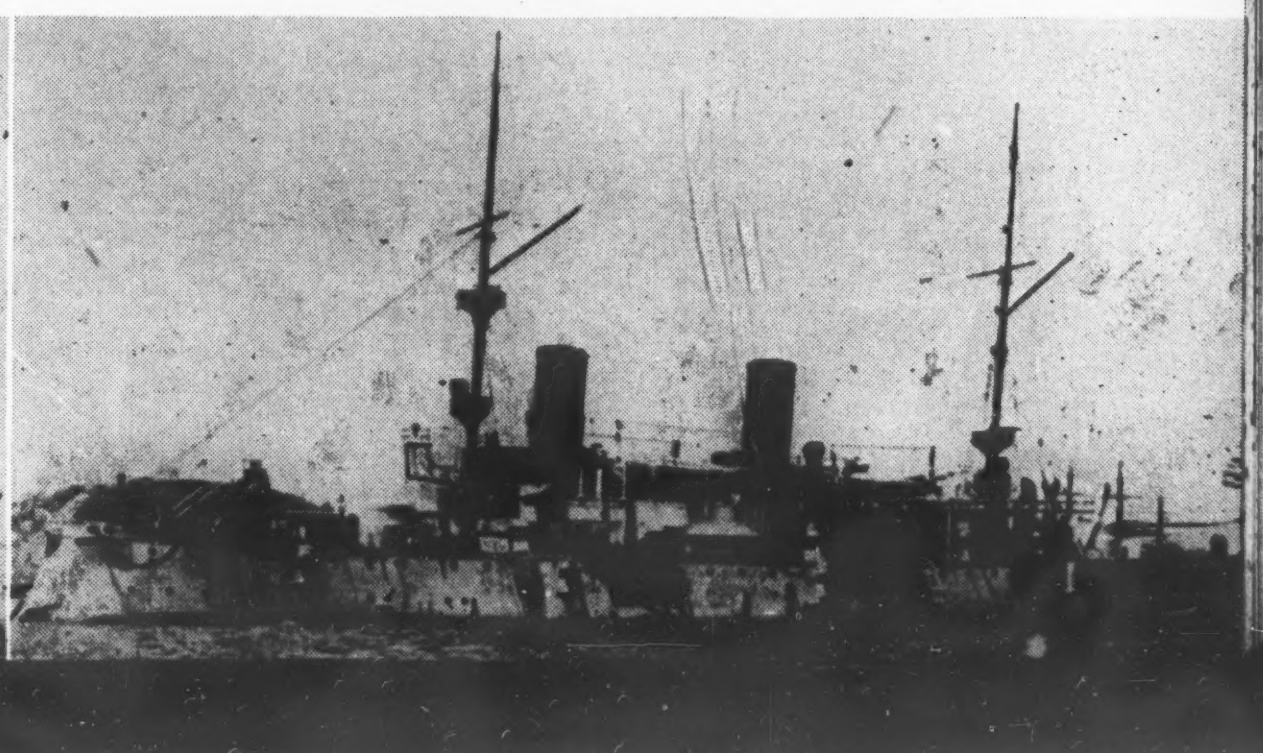
Below: The era of "Teddy" Roosevelt. During his presidency the Navy saw such expansion that his birthday, October 27th, is celebrated as Navy Day. Left—the victorious fleet returns to the States following the Spanish-American War. Right—President Theodore Roosevelt addresses officers and men aboard the USS *Connecticut* at the conclusion of the round-the-world cruise of 1907-09.





Below: The 14-inch guns, anti-aircraft guns, and the airplane perched on the catapult point up the advancement made since the "Teddy" Roosevelt era when the USS *Olympia* (right) was the flagship of the U. S. Fleet.

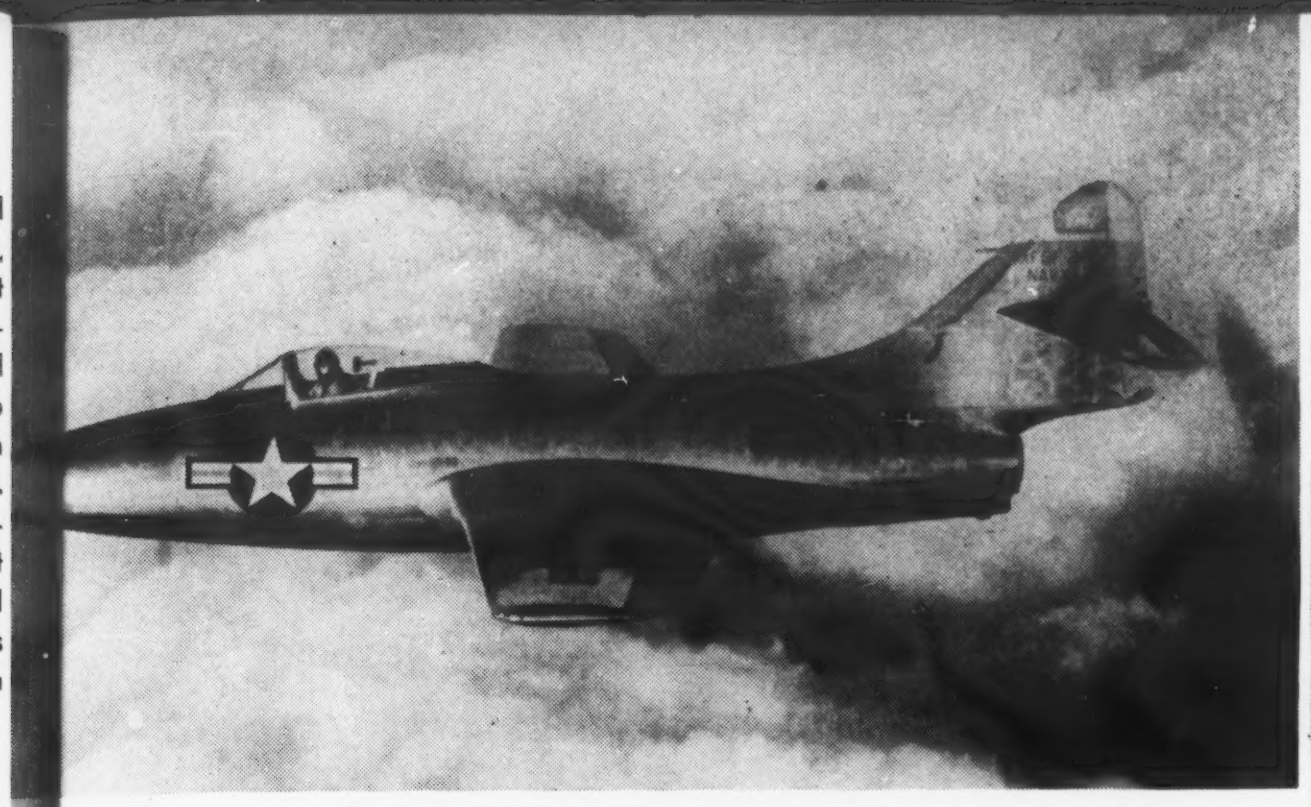


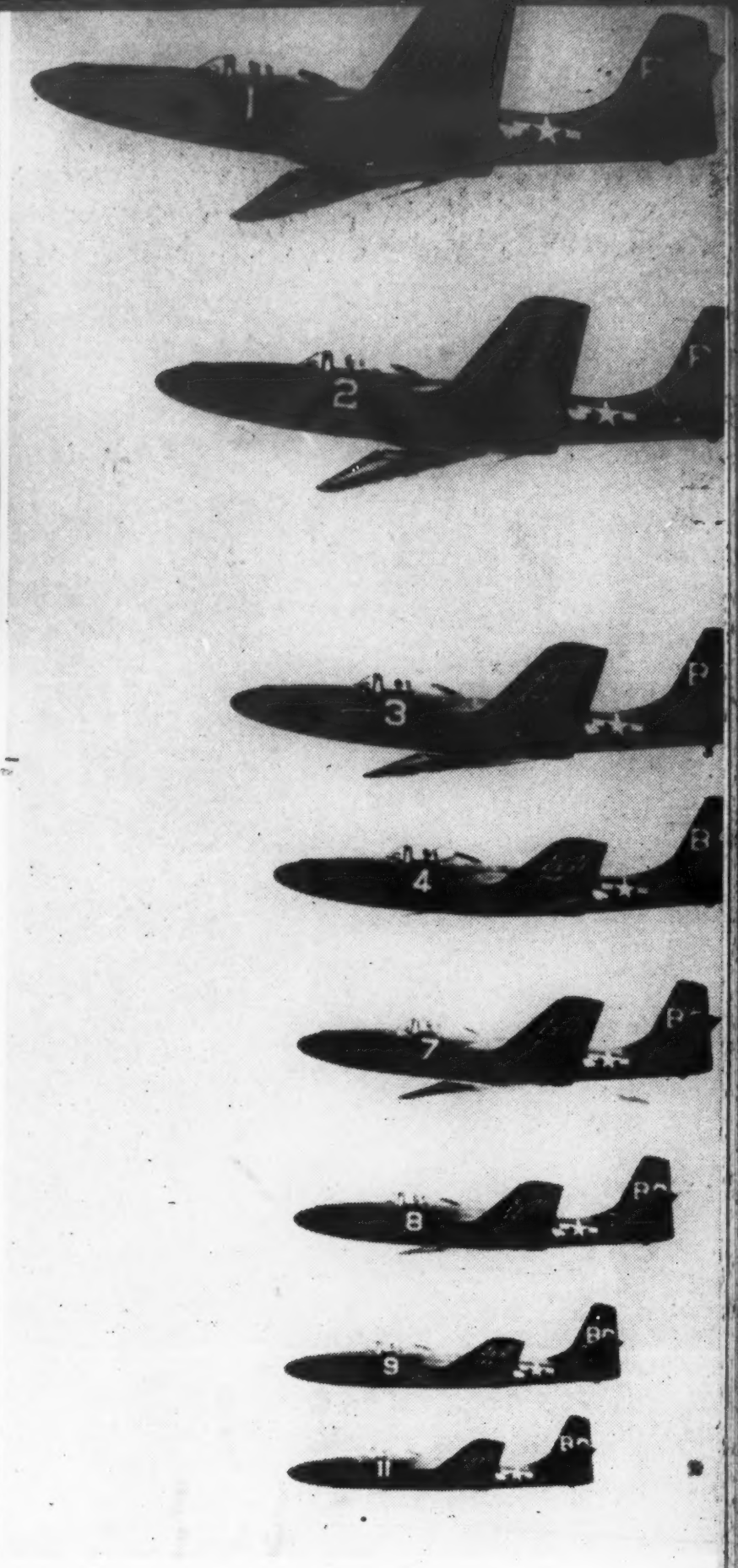


Pictured on this page are firsts and latests in U. S. Navy aviation. Top, Lt. Eugene Ely made the first flight from a ship, Hampton Roads, November 14, 1910. Ely was the real pioneer of naval aviation—he also made the first aircraft landing on a ship, San Francisco, January 18, 1911. It is interesting to note that the improvised arresting gear used for that landing consisted of lines stretched across the deck attached to sandbags —the same principle employed in modern arresting gear.

Second from top, an FJ-1 "Fury," jet-propelled Navy fighter makes a landing aboard the USS *Boxer*.

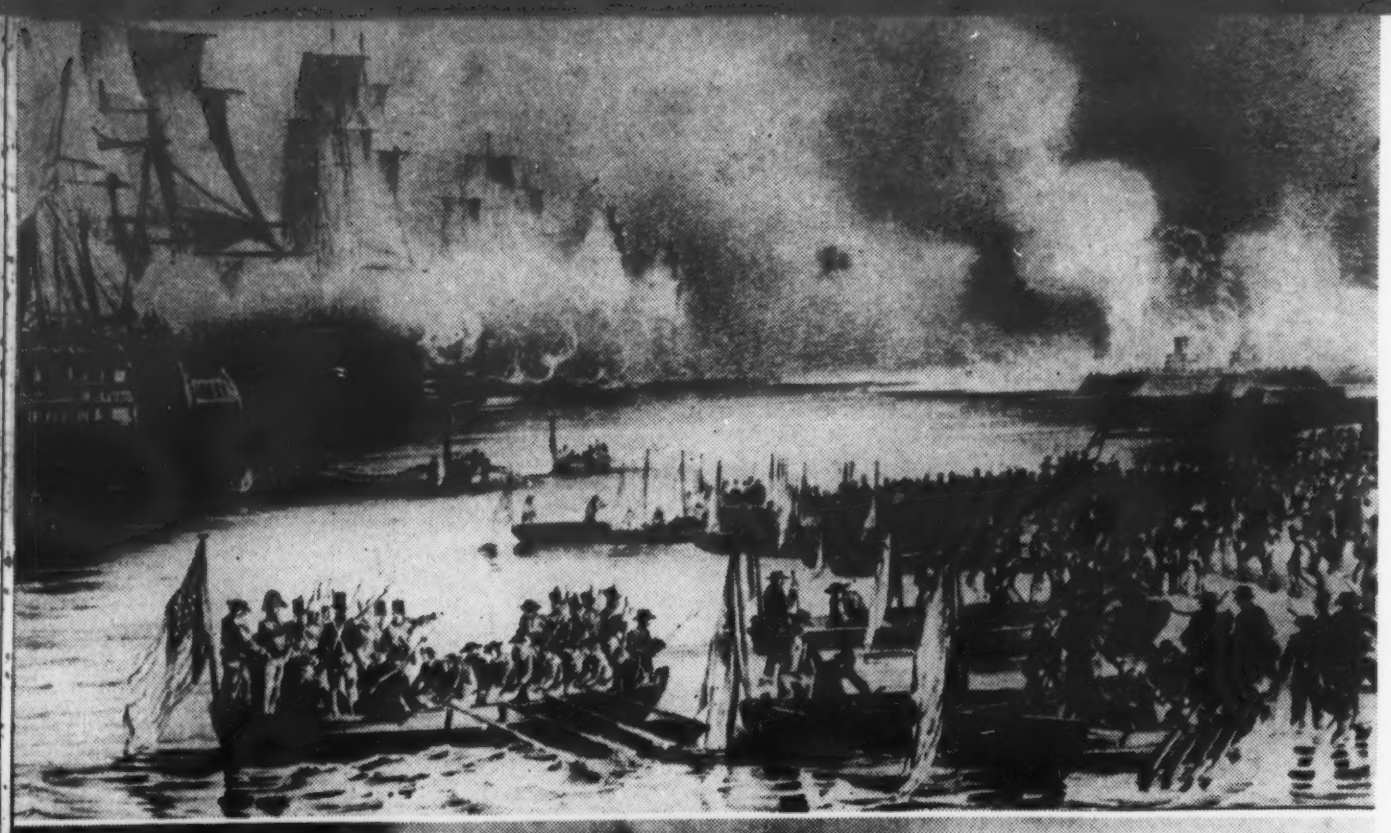
Below, the first "flat top." Converted from a collier, the USS *Langley* was probably as clumsy as she looked, compared to the latest in carriers, (bottom) the USS *Franklin D. Roosevelt*.





The latest in Navy aircraft, fighters and transport.
Right, Marine jet fighters, "Phantoms," in echelon.
Above, Navy jet fighter, the "Panther."
Below, The Navy claims its "Banshee" is the world's most powerful carrier based fighter plane.

Below, the Constitution, giant new Navy transport, shown at the Washington National Airport. (The Washington Monument shows forward of the nose, and the Capitol dome aft under the fuselage.)



A hundred years ago at Vera Cruz the Navy was putting landing forces ashore in boats rowed by hand. But the big ships were using the same technique of today, bombarding the land positions to cover the landings.

Probably no technique of warfare was so expanded during the last war as the amphibious phase. Center, hundreds of craft streak in for the Iwo Jima assault.

Below, in a few hours time landing craft put ashore supplies and equipment for an army.

By John J. Hession, Training Activity

The familiar blue-covered Navy Training Courses were developed to keep pace with changes and developments in Navy gear and Navy operations. Today these books are being given a thorough reexamination in the light of the revised rating structure. This present discussion will single out ratings and courses in the field of communications.

Much experience and thorough research, plus the lessons of the past war, went into the *revised rating structure,* prepared by the Research Activity of the Bureau of Naval Personnel. This new organization of general service and emergency ratings has been published in the *Manual of Qualifications for Advancement in Rating* (NavPers 18068). Now, in operation, the peacetime value of the revised qualifications can be asessed. Furthermore, the armories throughout the nation can begin to foresee the worth of the new rating structure as a training and classification tool in time of emergency. The new rating system should always be examined as a *tool of readiness.* But, more than that, the system must bring incentive and opportunity to every man of the peacetime working Navy—if "career planning" is to prove more than a phrase.

The Training Activity of the Bureau of Naval Personnel is charged with the preparation of Navy Training Courses for rates and ratings of the Regular Navy and Naval Reserve. The courses lead straight from the *Manual of Qualifications;* the better the "Quals" present an accurate job description, the better the course for advancement in that job is likely to be. Add to that the fact that the writer of Training Courses must have the fruits of fleet and armory experience. The lessons being learned in ships and on shore stations and in the Naval Reserve armories can now be profitable only if all hands concerned see to it that the word gets back to the Bureau. This is a follow-up procedure familiar whenever improvement is desired.

*Quartermaster**

The Quartermaster rating serves as a good example of the basic workings of the new rating structure.

GENERAL SERVICE RATING	=	EMERGENCY SERVICE RATINGS
QM		QMQ QMS

*Note to Army and Air Force readers: "Quartermaster" has not the same meaning in the Navy as it has in your branch.

We can say that the QM=QMQ+QMS, for in peacetime the QM combines the duties assigned to the Quartermaster and Signalman in the old rating structure. On shipboard the QM will serve as a member of the quartermaster gang under the navigator and of the signal gang under the signal officer.

On the bridge on any ship, then, the QM has a bigger job—and an important one. His notebook and his charts, yes, the stars and the sun—these are indispensable; so too are his flags and his flashing light, his Nancy and his signal books. He has much to learn, from experience and from the courses prepared for him by the Training Activity.

In operations and in communications the QM has a wide-ranging part to play. Once he knows his job, he can become the right arm of the navigator and of the officer of the deck underway. Note some of the QM's skills: helmsman in making difficult landings, operator of loran gear, taker of sights and bearings, reader of flaghoists, corrector of charts—even assistant navigator and signal officer. And to the limit that books can prepare a man to live up to his rating, the training courses should become for the QM an active part of his working library.

Teletype adjustment instruction for naval school teleman.

QUARTERMASTER JOB CLASSIFICATIONS

Expert lookout supervisors
Quartermaster, fleet operations
Quartermaster, river and harbor
Charts and publications men
Quartermasters, basic
Signalmen, fleet operations
Signalmen, beaching operations
Signalmen, harbor entrance control post
Signalmen, convoy operations
Signalmen, basic

The war-experienced Reserve as well as the postwar Reserve enlistee will continue in either the QMQ or QMS rating. Each is a man-sized task in itself. He will be expected to become as expert in his specialty in time of emergency as the general service QM who will then be serving with the Reserve in the same gang and in the same ship.

Reserve training officers will make the desired training courses available to Reserve enlisted men. The present courses cover the area fairly well; and within a year revised and up-to-date courses for Quartermaster and many other ratings will be ready for distribution to all armories.

Radioman

The general service rating of radioman (RM) also means greater responsibility and wider usefulness for the active Navy man today. In addition to working with radios and transmitters, the RM will operate direction finders, teletypewriters, voice radios, and facsimile equipment. The two emergency service ratings are Radioman N and Radioman T. The RMN performs nearly the same duties as the RM except that he does not operate a key telegraph. The RMT does that job and knows landline telegraphy, which uses the Continental Morse Code, familiar in railroad communications.

For the Radioman, skill in transmitting and receiving International Morse Code will continue basic, in spite of the vastly increased use of the teletypewriter. The aircraft carrier of today and tomorrow may well have as standard equipment as many as 100 radio receivers and transmitters. The far-flung range of carrier operations demands alert communicators. The RM will carry much of that burden.

Under the new rating structure the RM's duties have not changed materially, as shown by the Naval Job Classifications. However, the progress being made in radio communications and in electronics demands continued study and practice with new gear.

RADIOMAN JOB CLASSIFICATIONS

Radio repairmen
Radio supervisors
Radio operators, radio watch
Radio operators, basic
Telegraphers
Teletypewriter operators

The whole series of communications Training Courses has been planned, with the advice and approval of Chief of Naval Operations, to present a complete and comprehensive picture of naval communications. The books will overlap purposely. The RM or RMN who will work with RDF equipment will study chapters from the RD and QM series on plotting and on charts. The RM and the RMN will want increasingly to keep abreast of aspects of the Electronic Technician's duties. So too, the RM on a carrier will find profitable reading in the books on aircraft communications and aircraft radio.

In ships and in armories, training officers will be proud of the results achieved when they prepare a study program that selects courses and parts of courses best suited to each

Rear Adm. T. L. Sprague, USN
Chief of Naval Personnel

In this era of increasing specialization when experts are sought out and rewarded by positions of importance in civilian life, the U. S. Navy also is keeping abreast of new developments and offering its men careers equally attractive with greater opportunity for advancement. Experts with practical experience have worked out naval training courses enabling men who think in terms of a useful education and the future to acquire the knowledge and skill that can make them leaders.

No man worth his salt wants to remain in the position he is; all men want to get ahead in some worthwhile work and know that it will be appreciated and rewarded.

As a large organization with manifold activities, the Navy can provide openings for such ambitious men. If they show willingness and eagerness, the Navy will train them under experts. But the Navy also asks that men do some intelligent thinking about their future goals.

Career planning is what the peacetime Navy is now stressing for alert naval personnel desiring to do what they like best and can do best.

In communications, for example, a man can choose almost any field and concentrate on it with the help of training courses: radio in all its variety, electronics, cryptography, and crypanalysis.

Communications is only one example. The Navy offers chances for experts to become Special Duty Officers. If a man is interested in foreign countries and customs, he may embark on on intelligence career, become an SDO officer, live abroad, perfect himself in one or more foreign languages, and specialize in a particular field like government or geography. An SDO officer in photography may become an authority on such a subject as cinematography, or in public relations as an authority on the evaluation of propaganda foreign or domestic, or in psychology an authority on psychophysiology among aviators or submarine men.

More than ever before, the Navy encourages men to better themselves by planning their careers and taking advantage of post-war educational facilities and training that lead to promotion.

man's needs. The Reserve RMN who reads and studies each year the current *Radio Amateur's Handbook* will be one of the first to recognize in his Training Courses, at the armory or at home, the Navy side of worldwide communications systems. The field is broad and has many compartments:

TRAINING COURSES: For the RM and the RMN and RMT

Introduction to Communications	NavPers	10129
Radioman 1 & C		10107
Radioman 2		10109
Radioman 3		10111
Quartermaster 3 & 2		10023
Sonarman 3		10125
Electronics Technician's Mate 2		10143A
Electronics Technician's Mate 3		10145
Introduction to Radio Equipment		10172
Aircraft Communications		10313
Advanced Work in Aircraft Radio		10314
Typewriting Manual		10609

Teleman

Comparison of the general and emergency service ratings for Teleman shows the complex skills required for this new rating. As a clerical worker he is entrusted with keeping records and publications of high security value in the field of naval communications.

The TEL is the communication clerk, the TEP the registered publications clerk. The TEM is entrusted by the Navy Department and by the Post Office Department with all classes of Navy mail and with postal funds. In the higher rates, the Teleman, as a TEQ may be authorized by CNO to perform cryptoboard functions as well as to maintain electrical cipher machines. The Teleman will understand the maintenance and repair of all the gear he uses—the typewriter, the teletypewriter, voice radio, and cryptographic devices. The TET will operate primarily as a landline teletypist. And, sum total of all, the Teleman will learn by standing a teletypewriter watch to become a supervisor of the watch and to assume responsibility for the operation and upkeep of the station equipment.

Laboratory at naval school, electronics equipment, M.I.T. All gear is in operating condition and is used for practical study.

TRAINING COURSES: For TE, and TEL, TEP, TEQ, TET, and TEM

Introduction to Communications	NavPers	10129
Introduction to Radio Equipment		10172
Electrician's Mate 3		10105
Yeoman 1 & C		10401
Yeoman 3		10405
Navy Mail		10431
Typewriting Manual		10609

As is true of all Navy ratings, the TE rating demands much book study. Then must come on-the-job practice and experience. The Bureau's Training Courses can do much towards getting a man started; in his working library he will have many rating courses and reference books. For the operation and maintenance of his particular model teletypewriter, the Teleman will work directly with the manual supplied by the manufacturer. The rest calls for disciplined drill and wide opportunities of experience.

The wireless teletype will soon become very familiar on all types of Navy ships—thence comes the importance of the TE rating. The seagoing Teleman will be working with radio receivers, tuning them for teletypewriter reception. The radio-teletypewriter is also patched directly into the ship's transmitters, as in normal radiotelegraphy. The more the TE knows of radio channels, the more thorough job he can do. This Teleman rating is packed full of technical information and the man so rated will perform valuable duties at sea or on shore. Some indications of the ramifications of this new rating may be noted in the job classification schedule.

TELEMAN JOB CLASSIFICATIONS

Radio supervisors
Radio operators, radio watch
Cryptographers
Yeoman, technical
Teletypewriter operators
Mailmen
Registered publications specialists

The "shack"—communication office of the ship.

Brief forecast can be made, in summary, of the Navy Training Courses in communications that will be made ready in the coming months. The *Introduction to Communications* has been written for all men interested in communications ratings. The course contains introductory information necessary to qualify a man for advancement to the third class rate of Quartermaster (S), Radioman, or Teleman. The book will also prove of value to the Seaman with a limited opportunity for communication training. This course contains a brief history of communications, and a general treatment of the naval communi-

Instructor points out details of radar set to Plebe class.

cation organization, ashore and afloat. In the discussion of the various methods and systems used by the Naval Communication Service, no effort is made to deal with communication procedures. For that information the striker should study the Training Course for third class in the rating in which he is interested. The final chapter, "Communications in Amphibious Warfare," is designed to show the role of communications in coordinating the forces employed for invasion by sea.

Self-study courses in the bluebook series in the ratings of Quartermaster and Radioman will soon appear. Mention also should be made of the basic courses in mathematics and physics for pre-electronic training, as well as introductory courses in electronics.

The courses mentioned here are being prepared directly by the Naval Reserve Training Publications Project under the technical cognizance of the Training Activity of the Bureau of Naval Personnel. Advice and assistance in these communication rating courses are being generously given by naval schools and offices, including various offices in CNO and BuShips.

The Navy Training Courses are being developed to give men of the Navy and Naval Reserve well-rounded programs of self-study literature. Those responsible for enlisted training will achieve the Training Activity's goal—*a self-study course for every rate and rating.*

Communications Training for Naval Officers

The successful coordination of naval operations demands a comprehensive and efficient communications system. So vital to the naval service is the ability to transfer intelligence reliably and rapidly that communications assumes the position of a fundamental in the training of naval officers. Each line officer, whether he ultimately may be assigned to duties involving navigation, engineering, gunnery or any specialty is given a basic knowledge of communications potentialities and limitations, with emphasis on the methods and procedures employed in the naval service. Such fundamental instruction is given at the Naval Academy and in the Naval Reserve Officers Training Corps program, as well as at the General Line Schools, which are connected with the professional training of junior officers.

The several media of communications must be understood by each officer so that most effective use of facilities may be made in meeting any given need. These media vary from the hand semaphore to the advanced forms of radio-teletype, and include radiotelegraph, both manual automatic, radio-telephone, landline circuits, flashing light, flags, the mails, and even messengers.

With a foundation in the principles of communication techniques and using the official Naval Communication Instructions and special orders and directives for guidance, most officers assigned to communication duties "learn by doing." However, taken as a whole the communication system is complex, and special training must be given to a limited number of officers who will assist in planning, implementing and executing communication plans for fleet maneuvers and tactical operations. These officers must be schooled in all phases of practical communications, and become in effect the Navy's communication specialists.

Postgraduate Courses

To meet this need for highly skilled communicators a one-year post-graduate course in Applied Communications is conducted at the U. S. Naval Postgraduate School, Annapolis, Maryland. On the theory that the best supervisor and administrator can himself perform the duties of his subordinates, this course includes training in the art of radio operating itself as well as in the planning phases of communications utilization. The instruction covered runs the gamut from learning to copy radio code on a typewriter to the formulation of typical communication plans for major naval operations. Included is training in radiotelegraph, voice, visual and teletype procedures; organizational problems of communications ashore and afloat; the two "bibles" of naval communications, Communication Instructions and the General Signal Book; international communication rules and procedures; radio frequencies and their usage; aircraft communications; merchant ship communications; uses of deceptive operations and countermeasures involving both radio and radar; crytographic aids; communications involved in joint, combined, and amphibious operations; principles of tactical operations; fleet doctrine and tactical instructions; the Combat Information Center, with emphasis on the communication problems involved in fighter direction, fire control, shore fire control and countermeasures; basic tactics and naval tactical communications; and the principles, capabilities, limitations and operational features of radio, sonar, radar and associated circuits and equipment.

In the earlier days of naval communications, the communicators themselves performed all installation, maintenance and repair of radio

equipment. With the rapid and widespread progress in the electronics field and the addition of innumerable types of gear, including radar equipments, the need manifested itself for specialists trained in the upkeep of electronics apparatus. Electronics Officers thus have evolved, and, although they are not considered "communicators," electronics officers and communication officers are closely related. The electronics specialist keeps the equipment running, the communicator puts it to practical use.

Any discussion of the communications training of naval officers would be incomplete if we did not mention the courses for those officers who are responsible for the maintenance of equipment.

A twenty-four week course designed to familiarize junior officers with all phases of electronics materiel, and to qualify them to supervise the maintenance and repair of such equipment, is conducted at U. S. Naval School (Electronics Materiel), Treasure Island, California. This course includes instruction in the theory and applications of radar, loran, sonar, identification, and countermeasures equipment. Graduates supervise the work of electronics technicians and assist in training new personnel in equipment upkeep.

Great Lakes School

A more extensive course of one year duration is given at U. S. Naval School (Electronics Maintenance), Great Lakes, Illinois. Graduates of this course are equipped to perform installation and maintenance functions on all types of naval electronics equipment. Training here is at the engineering school level, with emphasis on the advanced applications of electrical and electronic engineering principles. Many officers attending this school are "career electronics specialists," having a wide background of experience in the communications and electronics fields.

Since 1946, an advanced twenty-month course has been conducted at

The Navy's Communication Chief, Rear Admiral Earl E. Stone.

U. S. Naval School (Electronics Engineering), Massachusetts Institute of Technology, Boston, Massachusetts. This course was planned to provide technical training of basic and long-range character, at the third and fourth-year engineering school level, for a selected group of officers, preparing for duty as electronics specialists. The program includes basic electrical engineering subjects, emphasizes the principles and applications of radio, radar, and sonar, and includes some instruction on atomic structure and nuclear physics. Graduates are prepared to undertake supervision of the installation and maintenance of future models of electronic equipment with relatively little additional preparation. They also are equipped to apply the general knowledge gained in a wide variety of electronic-engineering work for the Navy. Successful completion of the course leads to a degree of Bachelor of Science in Electrical Engineering.

The electronics school at the Massachusetts Institute of Technology was established as an interim measure, to be effective until such time as the output of the U. S. Naval PostGraduate School, Annapolis, Maryland, could meet the postwar requirements for electronics officers trained at the engineering and design level. The M.I.T. program will conclude in early 1949, with final graduation in February of that year.

The U. S. Naval Postgraduate School conducts a three-year course in Electronics Engineering, with a specially selected class of officers convening each summer. This course prepares officers to be competent supervisors over work relative to the specification, design, research and development problems of radio, radar, sonar, countermeasures, and other electronics apparatus utilized by the Navy, and to be competent supervisors over the installation of such equipment. Instruction includes the following phases: organization and administration of electronics facilities, afloat and ashore; principles of radio circuits; electricity; circuit analysis and measurements; advanced circuit theory; radio frequency measurements; principles underlying radio, radar and sonar; communications fundamentals; electron tubes; vacum tube circuits; pulsing and high frequency circuits; radio systems; transmitters and receivers; radar;navigational systems; antennas, transmission lines and wave guides; radio and radar countermeasures; sonar; electromagnetics; and radio frequency energy transmission.

In addition to the more extensive courses, numerous short courses at the familiarization and refresher level are conducted for officers who are changing duty stations or whose ships are tied up for limited periods of overhaul or repair. Such courses include the following for communication and electronics officers: communications, combat information center, countermeasures, radio, radar, oran, electronics, teletype, and sonar. For the most part, these short courses are given at various Fleet Training Centers, at CIC Team Training Centers, and at certain Naval Reserve Training Centers located at coastal points.

A one year post-graduate course in applied communications is conducted at the Naval Postgraduate School, Annapolis.

THE MARINES' NAVAJO "CODETALKERS"

Throughout the Solomons, in the Marianas, at Peleliu, Iwo Jima, and almost every island where the Marines stormed ashore in the war, the Japanese heard a strange language gurgling through the earphones of their radio listening sets—a voice which defied decoding. To the linguistically keen ear it showed a trace of Asiatic origin, and a lot of what sounded like American double-talk.

That strange tongue was Navajo embellished with improvised words and phrases for military use. For three years it served the Marine Corps well for transmitting secret radio and telephone messages in combat. The dark-skinned black-haired Navajo code talker, huddled over a portable radio or field phone in a regimental, divisional or corps command post, translating a message into Navajo as he read it to his counterpart on the receiving end miles away, was a familiar sight in the Pacific battle zone.

Navajo Codetalker . . . a familiar sight in the Pacific zone.

By nature of its distinct position in the military defense of this nation, the U. S. Marine Corps must supplement normal procedures with innovations of its own. In the communications field the Marine Corps, admittedly the forerunner in development of amphibious technique, added to standard operating procedure the employment of Navajo Indians as "code talkers." This heretofore classified program took an old cryptographic principle and applied it with success in the Pacific operations of World War II.

Transmitting messages which the enemy cannot decode is a vital military factor in any engagement, especially where combat units are operating over a wide area in which communications must be maintained by radio. Throughout the history of warfare military leaders have sought the perfect code—a code which the enemy could not break down, no matter how able his intelligence staff.

Most codes are based on the codist's native language. If the language is a widely-used one, it also will be familiar to the enemy and no matter how good your code may be the enemy eventually can master it. Navajo, however, is one of the world's "hidden" languages; it is termed "hidden," along with other Indian languages, as no alphabet or other symbols of it exist in the original form. There are only about 55,000 Navajos, all concentrated in one region, living on Government reservations and intensely clannish by nature. These factors have confined the tongue to its native area. Complicating the Navajo language, there are dialect variations among the tribes, and in some cases even dialects within a tribe.

Except for the Navajos themselves, only a handful of Americans speak the language. At the time the Marine Corps adopted Navajo as a voice code it was estimated that not more than 28 other persons, American scientists or missionaries who lived among the Navajos and studied the language for years, could speak Navajo fluently. In recent years, missionaries and the Interior Department's Bureau of Indian Affairs have worked on the compilation of dictionaries and grammars of the language, based on its phonetics, to reduce it to writing. Even with these available it is said that a fluency can be acquired from prepared texts only by persons who are highly educated in English and who have made a lengthy study of spoken and written Navajo.

Germans Missed Navajo Study

One of the reasons which prompted the Marine Corps to adopt Navajo, in preference to a variety of Indian tongues as used by the AEF in the last war, was a report that Navajos were the only Indian group in the United States not infested with German students during the 20 years prior to 1941, when the Germans had been studying tribal dialects under the guise of art students, anthropologists, etc. It was learned that German and other foreign diplomats were among the chief customers of the Bureau of Indian Affairs for the purchase of publications dealing with Indian tribes, but it was decided that even if Navajo books were in enemy hands it would be virtually impossible for the enemy to gain a working knowledge from that meager information. In addition, even ability to speak Navajo fluently would not necessarily enable the enemy to decode a military message, for the Navajo dictionary does not list military terms, and words used for "jeep," "emplacement," "battery," "radar," "antiaircraft," etc., have been improvised by Navajos in the field.

The adoption of code talkers by the Marine Corps stemmed from a request for Navajo communicators by Maj. Gen. Clayton B. Vogel, then Commanding General, Amphibious Corps, Pacific Fleet. A report submitted with this request said a Navajo enlistment program would have full support of the Tribal Council at Window Rock, Ariz., Navajo Reservation.

Acting on this request, the Marine Corps' Division of Plans and Policies in March 1942 sent Col. Wethered Woodworth to make a further report on the subject, and a test was made at the San Diego, Calif., Marine Base to determine the practicality of Navajos as code talkers.

The test revealed that the Navajos who volunteered for the experiment could transmit the messages given, although with some variation at the receiving end resulting from lack of exact words to transmit specific military terms. For example, "Enemy is pressing attack on left flank" would come out "The enemy is attacking on the left."

Proper schooling in military phraseology, it was believed, could correct this variation, and the following month the Marine Corps authorized an initial enlistment of 30 Navajos to ascertain the value of their services.

The enlistment order required that recruits meet full Marine Corps physical requirements and have sufficient knowledge of English and Navajo to transmit combat messages in Navajo. The recruits were to receive regular Marine training, attend a Navajo school at the Fleet Marine Force Training Center, Camp Elliott, Calif., and then receive sufficient communications training to enable them to handle their specially qualified talent on the battlefield.

Marines added to standard operating procedure the employment of Navajo Indians as codetalkers.

Language Variation Problem

All the recruits spoke the same Navajo basically, but there were certain word variations. In Navajo, the same word spoken with four different inflections has four different meanings. The recruits had to agree on words which had no shades of interpretation, for any variation in an important military message might be disastrous. As might be expected in any group of youths, they were not equal in education or intelligence. Some military terms were very complex to the unschooled; all had to be able to understand them thoroughly in order to translate them into their native language. Some were not easily adaptable to communications work. It was difficult in several instances for non-Navajos to instruct the recruits in Marine Corps activities; a few marine instructors were unable to cope with the typical Indian imperturbability.

On the other hand, many of the recruits were well-educated, intelligent and quick to learn. A number had worked for the Bureau of Indian Affairs as clerks, and almost all the Navajos had the highly developed Indian sensory perceptions.

Code talkers manned distant outposts, maintaining contact in Navajo by radio. It was found best to have close friends work together in teams of two, for they could perfect their code talk by personal contact.

There had been concern in some quarters that dark-complected Navajos might be mistaken for Japs. In the latter days of the Guadalcanal action one Army unit did pick up a Navajo communicator on the coastal road and messaged the marine command: "We have captured a Jap in Marine clothing with marine identification tags." A marine officer was startled to find the prisoner was a Navajo, who was only bored by the proceedings.

The code talkers went on into more campaigns, proving their ability, and the Navajos quota in the Marine Corps rose from 30 to 420. At their TBXs they transmitted operational orders which helped us advance from the Solomons to Okinawa.

Navajo recruits meet full Marine Corps physical requirements.

Navajos Indispensable

It was found that the Navajos are not necessary at levels lower than battalions. For messages beween battalions and companies the extra security is not required and speed is the paramount issue. The III Amphibious Corps reported that the use of the talkers during the Guam and Peleliu operations "was considered indispensable for the rapid transmission of classified dispatches. Enciphering and deciphering time would have prevented vital operational information from being dispatched or delivered to staff sections with any degree of speed."

At Iwo Jima, Navajos transmitted messages from the beach to division and corps commands afloat on D-day, and after the division commands came ashore, from division ashore to corps afloat.

On rare occasions, though, the Navajos did lapse into some typical Indian gyrations. Ernie Pyle, in one of his last dispatches from Okinawa, described how the First Division's Navajos had put on a ceremonial dance before leaving for Okinawa. In the ceremony, they asked the gods to sap the strength of the Japanese in the assault. The other marines looked on, interested and amused, but when the division reached Okinawa the Navajos pointed out the ease of the landing and reminded the division men of their pre-embarkation ceremony.

The part played by the Navajos in communications during the war left no doubt as to their value but it remained for the commanding officer of a famous Marine regiment to administer the final accolade, "excellent marines."

ELECTRONICS BEGINS IN RESEARCH

Material Prepared by Editorial Branch, Office of Naval Research

The history of the development of United States Naval power has followed closely the history of scientific development. A nation's naval tactics can be no further advanced than its technological advances. Commodore Dewey, operating in Manila Bay in 1898, for instance, without the benefit of radio, radar, and all the other complicated electronics equipment serving our naval officers today, was dependent on the human eye for determination of tactics. His sources of information about the enemy were extremely limited, confined almost completely to what could actually be seen of the enemy's power. He had to sight the enemy optically, he had to aim his guns optically, and he used semaphores as his only signalling equipment. Technological developments gave the naval officer in World War I better optical equipment and better gun sights, but still kept him largely dependent on the human eye. Tremendous technological advances in World War II, however, especially in the field of electronics, liberated the naval officer from this dependence on meager optical equipment. Tactics could now be planned so that it was not even necessary to be near the enemy to know his location, to fire on him, or to find out what he was doing. Radar, sonar, and other highly complicated technical advances changed the whole picture of naval warfare.

The proximity fuse, which played such a major role in the successful prosecution of the war, was a masterpiece of electronics development based on scientific research. It was essentially a complete radio set equipped with a power plant, transmitter, and receiver, all fitted into the nose of a shell. To meet Navy needs, the fuse had to perform within the following extremes in requirement; It had to be sensitive and rapid in operation, but not subject to being triggered by the passage of other shells or by the reflection of radio waves from the ground, water and clouds and also had to be capable of withstanding the tremendous shock of firing. It had to be safe to handle and not subject to serious deterioration in storage. Its development was one of the engineering miracles of the last war.

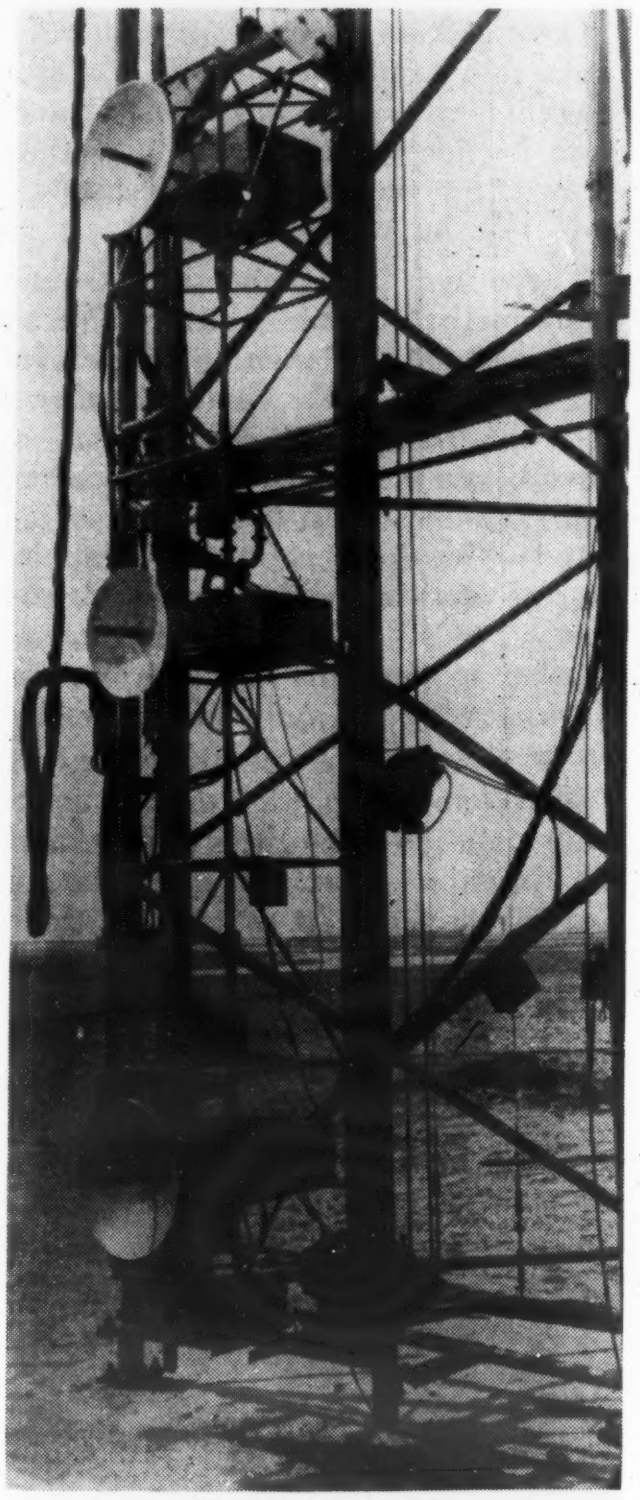


Fig. 1. Receiving antennas mounted on an elevator which can be raised and lowered on a receiving tower for more thorough study of angle-to-arrival problems. Top and bottom antennas are used in tests. Data from antennas permits calculation of angle-of-arrival for both direct and reflected waves which can thereby be differentiated.

The United States has always been ingenious in the application of knowledge for practical purposes. Our engineering ability is unsurpassed, but we have never been a leader in the creation of new scientific knowledge. Jet aircraft, rockets, Schnorkel submarines, and even the principles underlying the atomic bomb—all were born across the sea. In the first three instances the war ended before the enemy could take advantage of their lead. In the last instance we were swifter in developing the basic data.

Until recently, we thought we didn't have to worry about basic research. Our less practical-minded European brothers could do it for us while we concentrated on production of the products that paid off in immediate dollars. We rewarded the producer of goods and ignored the producer of ideas from which the goods originated. World War II upset this kind of thinking. In the first place, most of the fine European laboratories and research institutions were destroyed with little prospect of their restoration for some time. In other words, our scientific life line was severed and in self preservation we have had to take up where the European scientists left off. Secondly, the atomic bomb did more than end World War II; it proved dramatically that no nation that wanted to survive could ever ignore basic scientific research. It might well be the price of survival. The Office of Naval Research, therefore, was established at the end of the war to do the job of scientific research for the Navy and is now supporting the most extensive basic scientific research program in the country. Its fields of research are as fundamental and as comprehensive as science itself—chemistry, physics, nuclear physics, geophysics, mathematics, electronics, fluid mechanics, mechanics and materials, bacteriology, biochemistry, biophysics, environmental biology, physiology, psychology, psychophysiology, dentistry,

and of course naval sciences such as amphibious, air and undersea warfare armament, and power.

ONR's Program in Research

Contracts are made for basic research work with universities, private research institutions, and industry. These contracts are phrased in terms attractive to scientists engaged in creating new knowledge.

The Office of Naval Research recognizes the scientists' aversion to strict control, and hence the agreements provided for the scientists' four freedoms:

Freedom to initiate projects of apparent value.

Freedom to explore new avenues as they appear.

Freedom to publish the findings of their work on the premise that new knowledge of natural phenomena is inherently free.

Freedom to teach so that graduate students of a university under Navy contract, for example, may contribute to the program and that program may in turn contribute to their education.

The Office of Naval Research works closely with the Research and Development Board, recently established to plan and coordinate research and development activities of the Department of National Defense. The Chief of Naval Research is a deputy member of this Board, which consists of a civilian chairman and representatives from Departments of the Navy, Army, and Air Force. The Office of Naval Research is represented on each of the ten committees set up under the board for such activities as aeronautics, electronics, and geophysical science. Under the committees are various panels, on most of which ONR also has representation. The Board recommends measures to coordinate the research and development of the military departments and allocates the responsibility for various programs to the bureaus of the defense establishment. The implementation of the programs is the function of the responsible branches.

The work of the Office of Naval Research, however, is not confined to the implementation of programs allocated by the Research and Development Board. The primary function of ONR is to sponsor an extensive basic research program.

In electronics, one of the most important of the 21 fields being explored by ONR, there are approximately 40 contracts with 20 university, industrial, and private laboratories. The subject is divided into the fields of propagation, radiation and matter, electron ballistics, physics of components, circuitry, and systems.

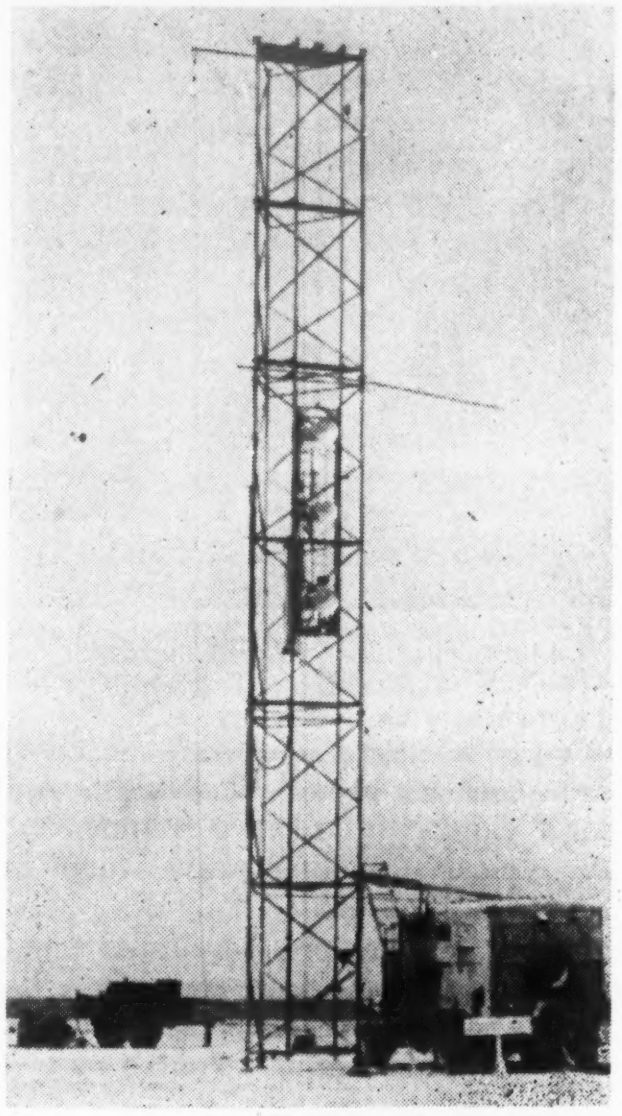


Fig. 2. Receiving antennas in raised position.

Propagation studies pertain to the propagation of radio waves at various frequencies, under various atmospheric conditions, and at various altitudes in the atmosphere. Radiation and matter is a study of matter under the influence of electromagnetic radiation, from X-rays through infrared and radio frequencies to direct current. Electron ballistics is a study of the dynamics of free electrons under the influence of electric and magnetic fields. Investigations of the physics of components are concerned with parts which go into electronic circuits, such as resistors, capacitors, and inductors. Circuitry, as the name indicates, concerns electronic circuits, or the path traversed by the electrons in electronic equipment. Systems studies relates to combinations of circuits, such as those used in communications among a group of ships, or in larger networks.

The relationship of these investigations to a fighting Navy will be readily apparent. Everyone is familiar today with the importance of radar to our armed forces during the war. A radar set aboard aircraft could spot accurately anything as small as a surfaced submarine 25 miles away, or draw a map through thousands of feet of fog or solid cloud cover so that bombers could demolish their unseen targets. Radar has indeed come a long way since the day Hoyt Taylor and his associates observed that radio waves were reflected by ships passing the Naval Research Laboratory on the Potomac; but its spectacular achievements should not obscure the fact that it still has limitations. For one thing a radar set cannot distinguish between a direct wave and a ground reflected wave. Problems connected with the propagation of radio waves are, therefore, being studied at the University of Texas under the sponsorship of the Office of Naval Research. (See Figures 1 and 2). In the course of these studies equipment has been developed which will determine within a few thousandths of a degree the angle of arrival of radar waves. When the angle of arrival can be accurately determined, the comparison of the components arriving at the receiver will distinguish between direct and ground reflected waves. The perfection of this technique will furnish a convenient tool for investigating a number of problems in the basic theory of microwave propagation. The Office of Naval Research is convinced that radar has an enormous future, but its tremendous possibilities cannot be exploited without further electronics research.

Another in ONR's propagation studies is under way at the Westinghouse Research Laboratories, where research men are measuring the backscattering of microwave electromagnetic energy from charged and uncharged raindrops of varying diameters falling at different precipitations rates.

A horn-shaped microwave antenna sends out radiation which either strikes the raindrop or is absorbed by a special material in the background. The energy striking the raindrop is reflected into a receiver placed at various distances and angles from the raindrop.

Radiation and Matter

Another important field of electronics is the study of the interaction of radiation and matter. The entire range of the electromagnetic spectrum is utilized, from X-rays to direct current; the matter utilized includes solids, liquids, and gases.

Different segments of the spectrum are used for different types of studies in this field. X-rays are used to investigate the crystalline structure of solids and the distance between atoms in crystals. Optical rays, or

Fig. 3. Infra-red Research Laboratory at M.I.T. The instrument at the left foreground and that in the center background are infra-red spectrometers. A girl is filling an infra-red absorption cell with a liquid. Spectrum is to be studied.

visible light rays, are used in studying the atomic and molecular structure of gases. Infrared radiation is suitable for work in the characteristics of gases and the structure of atoms. (See Figure 3.). This is the band of the spectrum employed in the Navy's night signalling devices developed during the war. (See Figure 4.). Invisible to the naked eye, these rays may be seen through a special viewer. Microwaves, in the next lower band of the spectrum, are used in determining distances between atoms, and the dielectric constants as well as other characteristics of gases, liquids, and solids. Lower radio frequencies are used to find dielectric constants of gases, liquids, and solids. Radio frequencies and direct current are applied to the study of breakdown voltages of dielectrics and insulators.

At the Massachusetts Institute of Technology projects cover the whole spectrum described above. At Princeton University the work is concentrated on the microwave band.

The practical applications which may possibly arise from this work are the synthesis of dielectrics according to engineering specifications and better insight into the propagation of electromagnetic waves through the atmosphere, since it, too, is a dielectric.

Electron Ballistics

In the electron ballistics field the Office of Naval Research is sponsoring work on a new electronic tube known as the traveling wave tube. The traveling wave tube operates on an entirely new application of the interaction of a traveling electromagnetic wave with an electron stream. The interaction strengthens the traveling wave at the expense of the electron stream, producing amplification. The most notable features of this tube not possessed by conventional tubes are its broad band width and high gain at microwave frequencies. A typical traveling wave tube is shown in Figure 5.

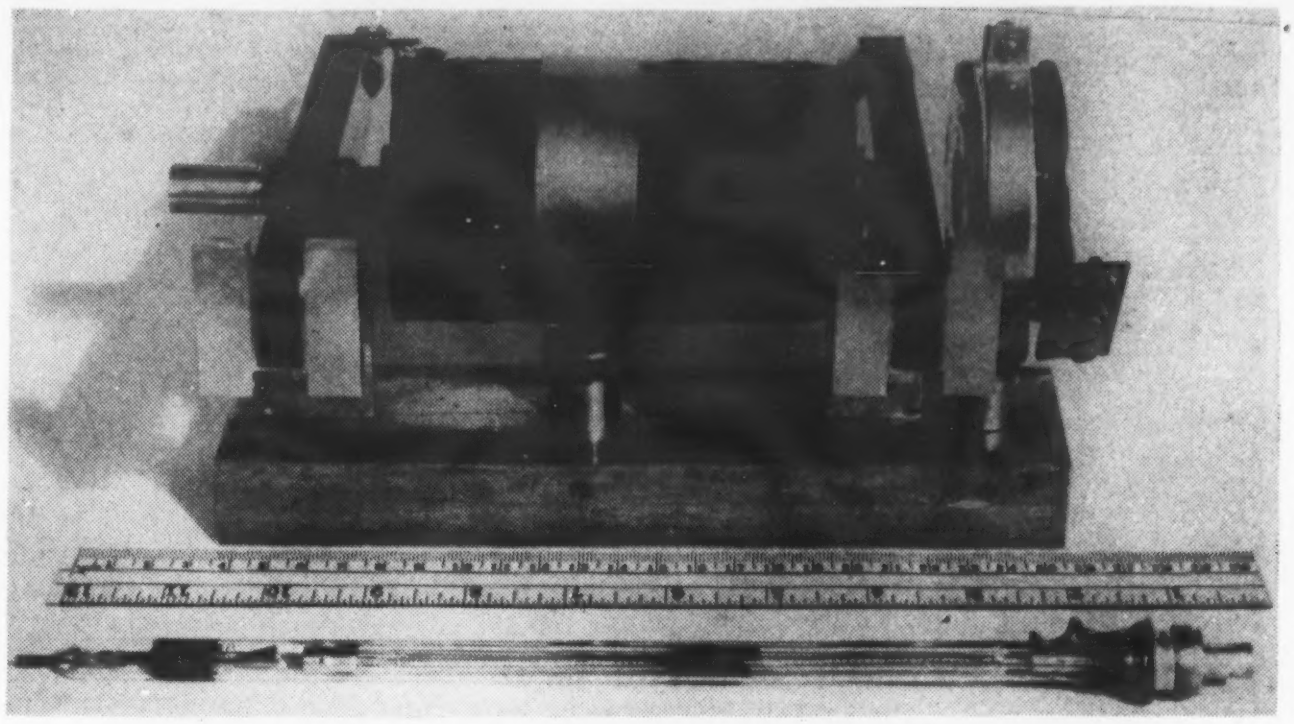
Even in its present unperfected form this tube shows promise. Its ability to amplify microwave frequencies directly without recourse to frequency changes make it suitable for television relay stations. The present high cost of laying coaxial cables for transmission of television programs is prohibitive for all but the densely populated areas, but by using relay stations a nation-wide network appears to be economically feasible. For frequency modulation similar applications could widen the coverage to many suburban areas. Microwave, links for multichannel communication could also be established at lower cost by the use of this tube.

Applications based upon the wide band amplifying properties of the tube are contingent upon other factors such as noise, frequency limitations, linearity, efficiency, stability of gain, size, weight, and power limitations. These factors require further experimental investigation, and the Office of Naval Research is sponsoring work at Stanford University, Massachusetts Institute of Technology, Harvard University, and the University of Illinois.

Navy 12 inch standard search light with special hood and filter for sending messages with infra-red light. Signalman is looking through special viewer and reading message sent with invisible light.

Although oscillation is generally avoided in the traveling wave tube, the phenomenon is found to occur under certain conditions. This discovery opens up a new avenue of investigation, and control of oscillation may lead to new uses for the tube. There are possibilities that generators for millimeter waves can be made on the traveling wave principle.

Another study in electron ballistics microwave generators with forty times the power of the best commercial magnetron. A new tube based on the Klystron principle, so far used only with very small power, around one-half watt, will be applied to give a 40 million watt peak output. In its practical aspects it will give us more powerful radar sets, increasing their range. It will be a better tool for linear accelerators in nuclear research.



Travelling wave tube in foreground is placed through center core of magnetic focusing coil in background. Rectangular openings are for waveguides. Incoming signal enters through waveguide on right, sets up electro magnetic field which traverses helix in the travelling wave tube. Interaction with electron stream shooting through cenral axis of helix amplifies signal which emerges through waveguide at left.

Circuitry

In the electronics circuitry program magnetic amplifiers are under study at the Carnegie Institute of Technology and the Polytechnic Institute of Brooklyn. These devices, using a magnetic circuit for controlling power, will in many cases replace vacuum tubes. A magnetic amplifier is especially advantageous because it is a rugged instrument made of iron with no delicate components such as vacuum tubes. Maintenance problems will be fewer, costs will be cut, and hence operation will be more economical.

Electronic Computers

Electronic computers, already in existence, can automatically perform arithmetic processes at extremely rapid rates in accordance with instructions prepared by the mathematician. Although an electronic computer cannot think, it has an advantage over the human computer in that it can solve problems in hours that might take him years. These amazing performances can still be improved by increasing the flexibility, speed, and memory capacity. Many problems of mathematical physics of extreme importance to the Navy, which could not previously be solved, will be within reach with the further development of such devices.

The Mathematics Branch, therefore, is supporting the development of an electronic computer for the National Applied Mathematics Laboratories, which will be available to all government agencies. A machine has been designed which will store from a thousand to five thousand ten-digit numbers, and which will be able to take two such numbers from the memory, multiply them together, and put the answer back into the memory in a thousandth of a second. Numbers and commands telling what the machine is to do with these numbers during the process of a calculation will be set up in coded form on magnetic tape and inserted into the machine. A start button will be pressed and the computer will transfer this information to the internal memory and proceed with the calculation without human intervention. The machine can even be told to alter the course of the computation depending on the results obtained at given points in the computation.

A very ingenious special purpose computer for crystal structure analysis is being built under a Mathematics Branch contract at the X-Ray Crystallographic Laboratory of Alabama Polytechnic Institute.

Realizing that computers will not be used to the best advantage without improved numerical techniques and a greater knowledge of how errors accumulate, ONR is also supporting the Institute for Numerical Analysis of the National Applied Mathematics Laboratories, National Bureau of Standards, which will study these and related problems. Support is also given to the mathematical work for the computer project at the Institute for Advanced Study, Princeton, New Jersey.

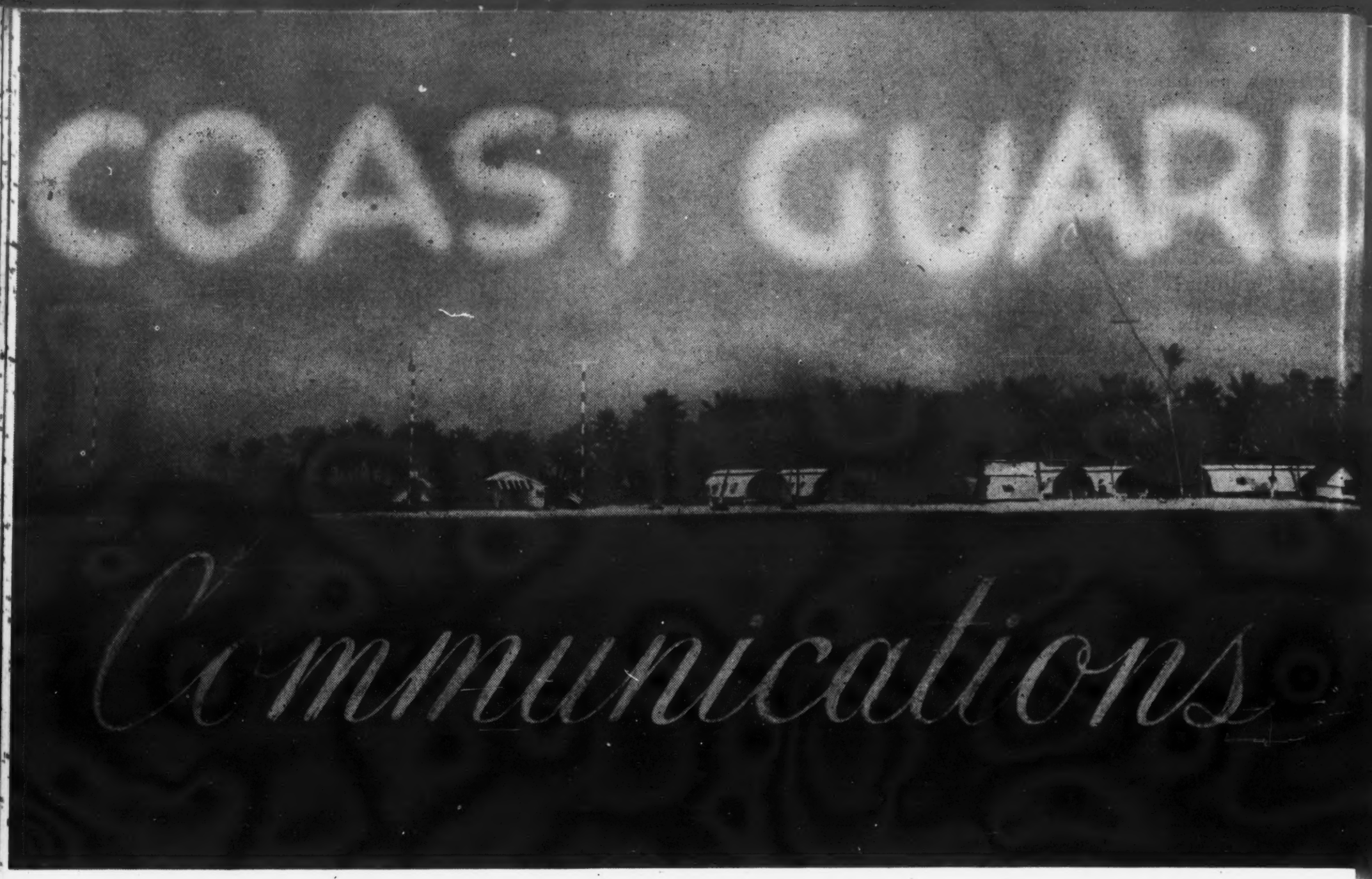
Research in Nuclear Physics

Electronics principles are applied to nuclear physics investigations under contracts of the Nuclear Physics Branch of the Office of Naval Research. Radar techniques developed during the war are used as tools to produce new radar techniques. Wide-band amplifiers have been developed to measure time of flight of nuclear particles and the coincidence of nuclear reactions. Radars with increased power output are being developed in order to build improved linear accelerators.

At Yale University a high-current electron gun has been designed to propel electrons at from 5 to 10 thousand electron volts. By assembling ten sections, electron energies from 20 to 30 million electron volts are expected.

These examples are merely the highlights of the basic research the Office of Naval Research is performing in the field of electronics. Research is also under way concerning high frequency discharge through gases, X-ray diffraction, cathodes for electron tubes, direction finding systems, non-linear electrodynamics, and numerous other projects. These studies all show that the Navy is attacking its problem at their roots. They are evidence of a modern, effective, fighting force.

At the same time, in pursuing basic research the Navy is investigating fields that will serve all mankind in peaceful endeavor. Fundamental knowledge is as important to the civil economy as it is to the Navy. Fundamental research in electronics will serve the electrical engineer engaged in civilian pursuits just as it serves the Naval engineer, for electronics everywhere begins in research.



The United States Coast Guard, with its many peacetime duties, is constantly alert to the over-all importance of good communications—well knowing that the wheels of a successful mission are powered by the main spring of communications. In every possible phase of operational activity, from the smallest job of helpfulness to the largest task of rescue, the Coast Guard communication system is reliably geared to serve whatever purpose the situation may require.

The Coast Guard first learned the real value of long distance communications in 1878, at which time a landwire service was established between Cape Henry and Kitty Hawk, linking together the twelve life-saving stations in that area. This network soon proved its worth as a life-saving medium—and thus began the Coast Guard's communication system. Within a few years after Marconi succeeded in his initial wireless telegraphy experiments (1889-1901), the Coast Guard (then known as the Revenue Cutter Service) was making use of his system in carrying on communications between ship and shore. As time progressed, up to the present, many means of communication invented or explored have found their place in Coast Guard communications.

In previous years Coast Guardsmen were taught that their main responsibility was to safeguard life and property on the high seas. Due to the rapid expansion of rescue services during the past decade the "high seas" part has more or less become obscure. Coast Guardsmen now understand that they are to safeguard life and property. In each undertaking of rescue, regardless of the situation, Coast Guard forces of the land, sea and air maintain a constant state of readiness—prepared to act immediately as an individual, a unit, a group, or a combination of groups. Needless to say, the communication system must bear the brunt of all eventualities, to insure that the forces of concerted action are swiftly and reliably informed. In a sense it can be said that the communication system is the watchdog of operations. This system of watchdogging requires close cooperation and mutual understanding of all responsible personnel, particularly the working together of the men who operate electronics equipment and the engineering personnel who bring about its design, construction, procurement and installation.

For many years the Coast Guard sailed along in a deliberate manner of stability with two specific branches of service, linked together as the Marine Corps is with the Navy. These two branches were commonly and officially referred to as the "cutter" and "life-saving" branches. The former operated ocean-going surface craft while the latter maintained life-saving stations along the ocean coasts and shores of the Great Lakes. Each branch operated somewhat independently of the other, but the facilities of each were pressed into joint action whenever the occasion neces-

The Coast Guard is committed to follow the pattern of Navy Communications, for in time of war the Coast Guard becomes part of the Navy

itated, both branches being under he jurisdiction of the respective dist-rict commanders.

Communications during that era were fairly simple. The cutters were conveniently outfitted with up-to-date communication apparatus for regular ship-shore contact, each district commander having one or more shore radio stations within his district to implement the system. The district headquarters maintained a communication center connected to the district's main radio station by teletype or other landwire service. The life-saving branch relied exclusively on landwire facilities for contact between themselves and, of course, with their respective district commanders or section offices.

Early Radio Equipment

A program was instituted in the early 30's to equip these stations with radio and also to equip the small craft which operated from these stations. This program made possible a closer coordination between the two branches, and communications personnel of both branches contributed much toward bringing their forces to the point of really knowing each other. The life-saving stations were set up on the same frequencies employed by the cutter service. Consequently, radiomen on the cutters exchanged conversation and information with surfmen operating the station equipment. In addition, radiomen of the cutter branch were designated to service life-saving station equipment which helped pave the way toward familiarity with each other's communications problems. The life-saving stations found a real value in radio communication. It gave the station rapid contact with its craft, thereby saving much time, energy, and "goose chasing."

Up until 1939 all matters of communication were administered under one divisional head. These included the responsibility for communication operations as well as the engineering and materiel end. The division was split into two separate divisions in 1939 when the U. S. Lighthouse Service was made a part of the Coast Guard. As the situation now stands the Coast Guard communication system is administered in unison by the communication operations division and the electronics engineering division.

With the induction of the Lighthouse Service into the Coast Guard there arose many perplexing problems which were eventually straightened out by the efforts of still another division (Aids to Navigation), necessarily established because of the wide difference between activities of the Lighthouse Service and the Coast Guard. After incorporation the former Lighthouse Service men really went to work with electronics equipment. Their efforts resulted in an ingenious network of radio controlled buoys and the many other aids to navigation that are now used. At present they are in the process of perfecting a radio controlled (unattended) lightship. This will undoubtedly solve the "gripes" of Coast Guardsmen assigned to lightships, which is anything but an exciting tour of duty. A lightship goes nowhere and duty aboard one is sheer monotony. However, there must be lightships, and lightships there will be; but perhaps in time there won't be any men on them to suffer the inevitable wear and tear on morale.

Ocean weather observation station aboard CGC Duane. Balloon has been located on the radarscope and its bearing and slant range are given by the radar operator to the recorder each minute.

Maintenance

In bygone days the service had but one branch of personnel to maintain all aspects of the communication service—the radioman. However, the old system of radioman (operators) being their own technicians has ceased to be. The work load had become burdensome, and there were the ever present problems relative to appropriate training. Electronics equipment of various types and sizes had rolled off the assembly lines pretty fast and it consequently developed that there would be two specific ratings for communications personnel, the operator and the technician. This split made the way easier for all concerned, particulary for the educational branch which is charged with training. In any eventuality, the Coast Guard is committed to follow the Navy's pattern relative to branch ratings, schooling, etc. This is quite necessary by virtue of the fact that the Coast Guard becomes a part of the Navy in time of war. It therefore pays early dividends in time and expense to keep abreast of the Navy in matters of communication operations and materiel.

North Atlantic Patrol

The North Atlantic Ocean Weather Patrol service began in 1940 by order of the President. The Coast Guard fell heir to the job, each vessel assigned being technically aided by personnel from the U. S. Weather Bureau. This job really caused some problems. The Coast Guard had become regularly accustomed to "short hauls" and convenient distances. Consequently, all radio communication equipment was designed accordingly, no transmitter in the entire service having a power output rating of more than one kilowatt—and all except a few of them rated less than 200 watts. After many trials and errors, shipboard and shore station equipments were finally brought up to a workable level. In the meantime, radio operators of the weather patrol ships and the shore station gang were obliged to squeeze their earphone cords to extract signals that just barely made it, and sometimes didn't make it. Then along came the war with its many interruptions to established weather reporting service. The Coast Guard was obliged to withdraw its first class cutters from weather patrol to outfit them for combat. Ocean-going craft of assorted shapes and sizes were substituted. This meant a hurry-up installation job and all the troubles that go hand-in-hand with such an occasion. During the early part of the war weather patrolling became a function of Task Force 24. Frigate class vessels were later used for weather patrol. The communications part of the frigates proved to be satisfactory and everything worked fairly well until the

ships themselves commenced to break up under the strain of North Atlantic storms, hurricanes and icing. Task Force 24 maintained the ocean weather vigil until March, 1946. The job was continued under Coast Guard supervision, the Coast Guard having resumed its peacetime status with the Treasury Department. The job of weather patrolling never actually got out of the Coast Guard's hands. Task Force 24 was administered by a Coast Guard Rear Admiral. When the war ended the Coast Guard's regular 327 ft. cutters were reconverted to their peacetime design and sent back to weather patrol duties. In addition, the Coast Guard has acquired some new 255′ cutters and a few 311′ Navy seaplane tenders. These three classes of vessels are now regularly employed on weather patrol schedules. Equipments are for the most part Navy standard. Some of the receivers, and combination transmitter-receiver sets, are of Coast Guard design. For certain special phases of weather patrolling even commercial equipment is in use. The patrol vessel's shore station is equipped with directional (rhombic) antennae, transmitting and receiving, thereby adding to the efficiency. Needless to say, unless communication operations of the weather patrol set-up are in good steady performance, there would be little need for a ship to patrol. Weather and meteorological reports must be in the Weather Bureau within one hour after observation in order to have any significant value. Therefore, much speed is required, not only in taking the observation, but also in preparing the code numbers used in texts of the report and actually getting the message for each observation into Washington. Under ordinary conditions, these reports reach the Weather Bureau in a matter of minutes.

New Title, Old Story

Many pages of information could be compiled to even briefly describe in detail all phases of Coast Guard communications. The system is widespread, designed to tie into an efficient net the many Coast Guard services. The Search-and-Rescue phase requires more extensive facilities than ordinary channels. In this instance, the presently used term Search-and-Rescue is merely a "hand-me-down" from the late wartime title Air-Sea-Rescue (ASR)—an elaborate name agreed upon by the combined communications board. Both terms can easily be traced all the way back to a law of December 22, 1837 (R.S. Sec 1536) which charged the Revenue Cutter Service with the job of life-saving in plain language. Although the new title Search-and-Rescue is seemingly appropriate, the over-all performance of that duty by the service is an old, old story in revised form and strategy.

Coast Guard Loran station on Saipan, Antennae hut.

Coast Guard Mission

The mission of the Coast Guard, and the position it occupies among government agencies is a unique one in many respects. The Coast Guard, being charged with the protection of life and property at sea is the organization concerned with keeping the mariner out of trouble, for once the mariner is in trouble it devolves upon the Coast Guard to assist him. This over-simplification of the functions of this organization may be extended to the types of electronic equipment required by the Coast Guard. The electronic equipment used by the Coast Guard may be divided into two categories: that used for communication and search purposes, and that used for aids to navigation. It may be seen that the second category is the equipment designed to furnish the mariner with sufficient information to permit him to navigate safely. In the event that he does get in trouble, the Coast Guard requires an excellent communication and search system to coordinate its efforts and direct its operational forces to extricate him from his difficulties.

Marine radio aids to navigation are generally divided into three classes: those used for long range navigation; those used when approaching land at medium ranges; and those used for entering harbors and for pilotage. The loran system supplies navigational information at distances up to 1500 nautical miles; marine radiobeacons provide fixes out to approximately 200 miles; and radar and radar beacons are used at the very short distances.

Loran Growth under CG

The principles of the standard loran system (1800-2000 kilocycles) are by now sufficiently well-known as to need no reiteration here. The operation of this revolutionary system, based upon pulse-hyperbolic principles, has been the responsibility of the Coast Guard since its beginning. When the original two N.D.R.-C. experimental loran stations were placed in regular operation the Coast Guard was assigned the task of installing the remainder of the system which was rapidly expanded during the early days of this country's participation in the war. The Coast Guard was therefore the organization charged with the practical implementation, or reduction to practice, of loran. That the system was effectively stabilized into a workable, accurate one is evidenced by its successful wartime use by 3000 ships and 30,000 aircraft, and its currently increasing adoption by civil marine and overwater air interests.

Briefly the outstanding characteristics of the system are that it provides navigational fixes over greater distances than any radio navigational aid previously in use, gives accuracy

comparable with good celestial observations, and is available at all times, day or night, fair weather or foul. The Coast Guard continues to operate 31 loran transmitting stations, which is Uncle Sam's share of the total of 37 stations which make up the almost world-wide system.

CG Designed Mobile Loran

To meet the operational needs of the invasion forces in the Pacific during the war, the Coast Guard also designed mobile loran units, mounted on trucks, thus adapting loran to be moved on the beach as soon as battle conditions permitted. Each unit comprised seven trucks—transmitter, timer, and power trucks, and cargo trucks for supplies and auxiliary equipment. Several such detachments were used in the Pacific theater. These mobile stations, since they carried loran equipment of the same types as installed at fixed stations, could not only provide the same service as a permanent chain, but could do so many times more quickly. The three or four stations of a mobile chain would move onto their locations and begin operation. Preliminary accuracy observations would be made, and computing and drafting personnel would begin construction of charts. Within a very few days, an accurate, completely verified, and charted loran system would be available to the navigators in the area. And, in turn, when loran service became available, the bombers could immediately carry less gas and more bombs because of the vastly improved navigation possible.

The transmitters which were used in the early days were simple but powerful self-excited push-pull oscillators. Obviously, this did not make for the greatest frequency stability. New transmitters being currently placed into operation during 1948 have their frequency controlled by the crystal oscillator of the loran timer, and use Class B linear amplifiers to produce an output of 1 megawatt—ten times that of the 100 kilowatt transmitters used originally. This timer crystal oscillator was originally developed specifically for loran, and is the most accurate known. Because of its great accuracy, approximately 3 parts in 10^9, this same loran oscillator is now used by WWV, the Bureau of Standards station, in connection with its standard frequency broadcasts.

Radio Beacon System

Because of the broad bandwidth characteristics of the transmissions of the older types of loran transmitters, loran operating agencies occasionally received complaints of interference from radio services operating on radio frequency channels adjacent to the loran band. The new transmitters mentioned above emit a much narrower band of frequencies than do the older types, and effectively confine the loran transmissions to the limits allocated at Atlantic City in 1947.

While the side bands of the existing stations are strong enough, in some instances, to cause interference to nearby channels, this is compensated for to a great extent by the fact that pulse transmissions are inherently susceptible to simple methods of elimination—much more so than c-w or other forms of transmission. Actually, an ordinary noise limiter in a good communication receiver will effectively eliminate pulses whose peak amplitudes are many times the amplitudes of the voice or c-w signals it is desired to receive.

To meet the needs of medium distance navigation, the Coast Guard operates the extensive marine radio beacon system of the United States, in the band 286 to 314 kilocycles. The basic radio beacon system has changed but little during the war, except of course, for the evolutionary refinements in equipment which are common to the radio field in general. It is still the mainstay of ships for medium distance navigation. One recent and important refinement is that of putting a number of these beacons on continuous-carrier, keyed modulation operation, so as better to serve aircraft and ships equipped with automatic direction finders. The percentage of modulation is carefully adjusted to give best performance to both aural null and automatic type duration finders.

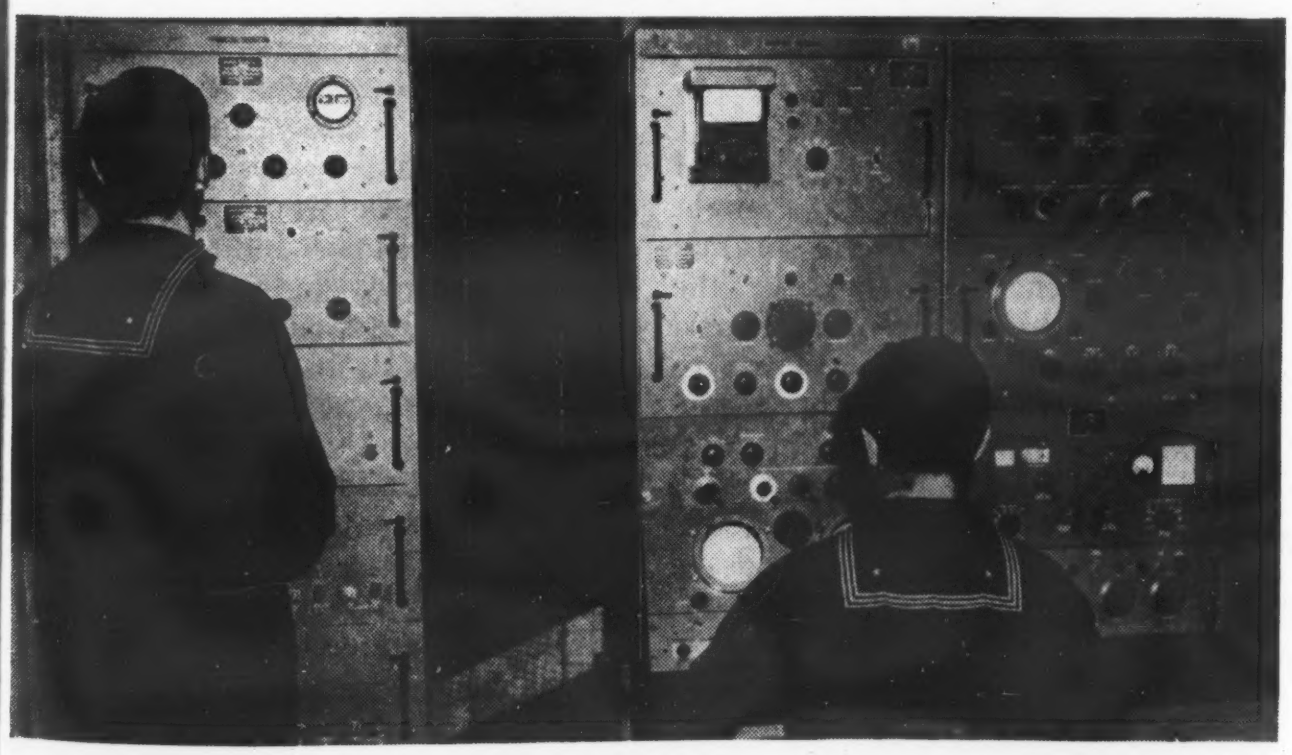
Secondary Beacons

All these radio beacon stations utilize crystal controlled transmitters, capable of delivering 25 or 150 watts and by addition of class B linear amplifier 800 watts of modulated signal, depending upon whether the beacon is designated as Class C, B, or A respectively. Power outputs of beacons at various localities are determined by a number of factors, such as the range required, potential interference to other beacons, etc.

Three beacons in a given area normally operate on the same radio frequency, and each beacon in this group of three transmits every third minute during two ten-minute periods of each hour during clear weather. During periods of low visibility the beacon operates every third minute around the clock. Accurate timing of signal in proper sequence is accomplished by a signal timer which is controlled by a master clock, which in turn is checked frequently against Naval Observatory time signals.

In addition to the larger radio beacons referred to above, a number of small Class "D" marker beacons are in operation. These are intended only for very short range local use, to indicate channel entrances, turning points, etc. A number of these are installed inside the large harbor entrance buoys at some of the important ports. Like the larger beacons, these are crystal-controlled with a power output of 5 watts. Two transmitters are mounted in the buoy and automatic changeover equipment shifts the operation from one unit to the other every few seconds, thus

Men on watch at the timing equipment at a CG Loran station.



Radio class in Coast Guard, Groton training station.

automatically indicating to the monitor station whether or not both transmitters are functioning. The transmitters utilize a common power amplifier tank circuit. The 14-volt d-c power is provided by batteries. A short whip antenna is mounted on the buoy. With occasional routine servicing, these small beacons operate very satisfactorily over periods of time.

Navigational Radar

The end of the war opened the way for merchant ships to acquire radar, which was classified during the war. Believing this development to be of great importance and highly adaptable to merchant ships, the Coast Guard has endeavored to encourage its use and adoption on such vessels. In this connection, the Coast Guard issued its "Advisory Minimum Specifications for Navigational Radar," which recommended the necessary characteristics of a modern navigational radar. All the commercial radars produced since the end of the war have met this specification, and in some cases have exceeded it. Considerable improvements in radar have been effected since the end of the war, particularly in the matter of eliminating excessive clutter, or sea return on the PPI scope.

At the present time, the navigational radar is getting a good reception from shipping interests upwards of several hundred vessels now having radar installations. It does not appear unreasonable that the day will come when all vessels of any appreciable size will be radar equipped.

Radar also presents interesting possibilities in the control of ships from the shore; a sort of GCA (Ground Controlled Approach) for ships. One of the most pressing needs in this connection is the control of traffic in large congested harbors in foggy weather or other conditions of poor visibility. It is often necessary for ships entering such harbors to wait at the entrance for extended periods of time before visibility conditions permitted them to continue safely to the dock. The Coast Guard is pursuing experimental work in this field. In addition, it is believed that the shore based radar may have possibilities for use in times of distress.

The Ramarck

In connection with the growing adoption of radar there is a need for some sort of radar beacon. While the simple navigational radar is particularly helpful in areas where pronounced, easily identified landmarks are available, there are many localities where it is very desirable to obtain azimuth indications from a beacon located at a known point. The Coast Guard has been actively pursuing for sometime the development of such a beacon, known as the Ramark.

At the present time, Ramark development is being carried out on two frequencies, 3256 mc/s (S-band) and 9310 mc/s (X-band). Each of these frequencies differ by a slight amount from that of the normal search frequency. To receive the Ramark the ship operator will need only to tune his radar receiver to the beacon frequency. Existing equipment utilizes magnetrons or klystrons. When dealing with unattended aids, which must operate with 100% reliability over extended periods of time, it will be appreciated that such equipment must be of extremely simple and rugged design.

Being so intimately concerned with developments in the Fields of Marine Radio Aids to Navigation, the Coast Guard closely follows all such developments in this field. It is perhaps not generally recognized that though the United States maintains excellent electronic navigational facilities, a great portion of the world is lacking in such aids. More important, however, is the lack of common facilities in the different countries. There is an internationally recognized need for standardization in this field, so that mariners of all nations will find the same types of navigational aids available in all parts of the world in which they sail. Complicating this picture are the various national opinions as to just which of the available navigational aids should be the ones made standard.

Primarily due to the great advances made during the war there are now a considerable number of navigational aids available which would suffice for the most of the mariners' needs, in greater or lesser degree. It is therefore no longer so much a question of finding an equipment or system which will do a particular job, but rather to choose among the many systems for one which is acceptable to all concerned, from technical, operational, and economic standpoints.

The Coast Guard has participated in both the international meetings on marine radio aids to navigation held since the end of the war, at London in 1946 and New York City and New London, Connecticut in 1947. Much valuable information has been exchanged through these media, and considerable progress has been made in reaching common understanding with other nations and toward international standardization.

Far Flung CG Districts

The communication needs of the Coast Guard are many and varied. A tremendous communications network is required merely to handle the routine administrative traffic of the organization. Communications are necessary to link together the 13 districts (which include the Caribbean area, Hawaii, Alaska, and the Aleutians in the Pacific), and to link the many shore stations and ships to each other and to the central authority of the district commander.

The needs of such a far-flung organization are not easily met by any one type of communication service; therefore we find many different systems in use, each suited to a particular requirement. The lifeboat sta-

tions along the shore, being separated by relatively short distances, use radiotelephony, or landline communications. Ships operating at considerable distances at sea communicate by means of c.w. on the medium high frequencies. All units within the district, however, are in communication by one means or another with the district primary radio station. This station is the nerve center of the district communication system. A number of these stations are equipped with very high-powered transmitters; 50 kilowatts on the 500 kilocycle band; 15 kilowatts on the medium high frequency band. These stations, as well as all the cruising cutters, maintain continuous watch on the distress frequencies, 500 kc/s, 8280 kc/s, and 140.58 mc/s. and are so equipped to communicate directly with ships and aircraft in distress. In times of distress, all these avenues of communication are used to coordinate the Coast Guard's efforts at rendering assistance.

Coast Guard air-sea rescue seaplane picks up a sailor seriously stricken and flies him back to hospital.

CG Equipments Modern

Because of the important function that communication plays in the Coast Guard's operation, ships are at all times equipped with the most modern equipment available. All Coast Guard vessels, 83 feet and over in length, are radar equipped. the larger of these carrying both air and surface search types, while the smaller vessels carry the surface, or general search types only. Communication equipment, through special arrangement with the Navy, is largely provided by that organization. This is done so that in times of emergency when the Coast Guard becomes a part of the Navy, ships need not be refitted with standard Navy equipment for efficient joint operation. All Coast Guard ships carry the most modern types of direction finders, loran receivers, etc.

In time of floods, and similar disasters, the Coast Guard cooperates with the Red Cross and other humanitarian agencies in rescue work. For this purpose, the Coast Guard maintains a fleet of modern communication trucks at strategic locations throughout the country. These trucks are self-sufficient communication units, complete with power generating equipment and with powerful transmitters for operaion on a broad band of frequencies. In many cases, these trucks have served to carry the main burden of communication from the stricken areas, and often have been the only link with the outside world.

One of the Coast Guard's duties is that of providing the ships for Ocean Weather Stations. The United States currently operates two of these in the North Atlantic Area, and one in the Pacific. The principal functions of these vessels are to make frequent observations of weather conditions, winds aloft, etc; to provide navigational service by means of a ship-borne medium frequency marine radio beacon; and to provide a strategically located vessel for search and rescue purposes. A recent illustration of the importance of this latter function is found in the case of the Bermuda Sky Queen, the flying boat which was forced down alongside the Coast Guard Cutter BIBB on Weather Station "C."

Communications are extremely important to satisfactory weather reporting. Observations must be cleared immediately to the Weather Bureau in Washington if they are to be of value; a report more than a few hours old is ancient history for purposes of weather prediction.

Aid to Flights

Over 1000 planes per month fly over the routes on which the Atlantic weather stations are located. While most flights are made with loran as the primary navigational means, most planes use the special "aerophare" radio beacons on the ocean station vessels to some extent, and also frequently request the weather ships to give them radar plots as supplemental checks on course and ground speed.

The Coast Guard maintains an up-to-date school at the training station in Groton, Connecticut for the training of its electronic technicians. Here courses in basic radio and electronics are available, as well as advanced and specialized courses in loran, radar, and other special equipments.

At the Coast Guard main radio station in Alexandria, Virginia, a communication laboratory is maintained for the testing and development of various equipments, for the fabrication of certain special equipment, crystal grinding, etc. The Coast Guard field electronic test station at Wildwood, New Jersey, performs a similar function with regard to field testing of antennas, etc.

The principal electronic warehouse and supply depot is at Jersey City, New Jersey, and the bulk of electronic equipment and supplies for the whole service pass through this activity which also includes an electronic repair shop for equipment repairs and electronic engineering inspection staff for inspection of electronic equipment delivered by contractors.

The principal electronic engineering staff for the Coast Guard is at U. S. Coast Guard Headquarters but each Coast Guard district also has an electronic engineering staff to keep the large electronic plant of the Coast Guard in operation.

NAVAL COMMUNICATIONS CENTER

Fig. 1. Typical naval relay center employing semi-automatic tape perforation equipment. All incoming and outgoing lines terminate in switchboards. Distributing frames show at the distant end of the room. Receiving positions are located in a row at the right hand side of the photograph. Each cabinet consists of eight typing reperforators.

The Naval Communications Service provides facilities for the transmission of intelligence by telegraphic type codes, voice and facsimile to and from ships of the Fleet and Shore Stations of the Naval Establishment. A world-wide net of radio stations is maintained to provide ship/shore and point to point circuits. This system is supplemented within the continental limits by an extensive system of channels leased from the commercial communications companies. Radio equipments are maintained in a state of operational readiness to provide continuity of communications despite any casualty to the leased plant. A naval communication center is a facility for the origin, final preparation for delivery and the relay of official naval communications traffic by the above stated means.

This article is concerned principally with that portion of the naval communication center which provides facilities for handling dispatch traffic, by far the major portion in point of volume of traffic handled. Other facilities provided are overseas telephone, radio photo and weather map facsimile services. The peak volume of dispatch traffic during the recent war at one of the larger communications centers was in excess of 2,000,000 words per day. Based on total personnel assigned to the center, including non-operating personnel, the pre-war traffic productivity was 1700 words per man per day. The peak load was handled at a rate of 2100 words per man per day, a net gain of 23%. This gain in large measure resulted from the use of teletype on radio circuits and the establishment of the U. S. Naval Teletypewriter System (NTX). During this period the circuit capacity of major trunk radio circuits were first quadrupled by introduction of four channel time division multiplex and later increased another fifty per cent by six channel frequency division multiplex equipment.

Radio facilities are established on the general principle that radio receiving stations must be located where the lowest noise level can be had within an area. Radio transmitting stations are located at the point within an area where ground conductivity and terrain permit operation of the equipment at optimum efficiency. Communications centers must be located to serve the commands for which they provide communications. These requirements dictate separations of 10 to 25 miles between the stations and the center. Keying control from the communications center to the transmitting station and from the receiver's station to the communication center is obtained by wire line, or channels derived from frequency division multiplex (carrier) (multitone) equipment operated over V. H. F. radio links. Narrow, medium and wide band channels are used to provide the range of keying speeds required.

Center Has Three Divisions

Communication control centers are divided into three main functional groups; a message center, a relay center, and a technological control center. The message center provides facilities for the origin of dispatches and preparation of incoming dispatches for distribution. The relay center provides teletype facilities which permit relay of messages on a torn tape basis, eliminating any requirement for manual repunching of

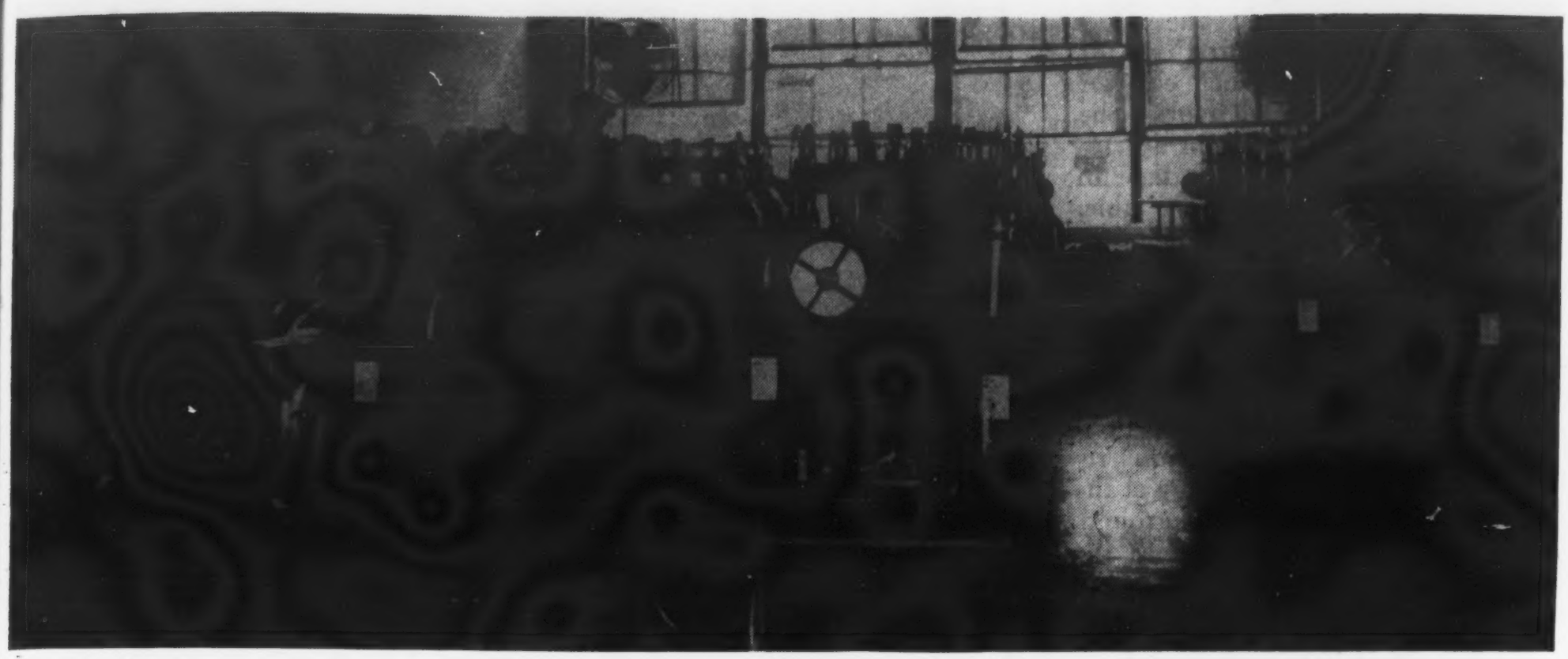


Fig. 2. Each duplex sending channel is monitored by a typing reperforator and a continuous tape record of all transmissions retained on a tape winder. All reruns are executed by utilization of the monitor tape.

dispatches. Technological control center includes all multi-channel equipments and a test regulating center.

Message center sending positions are normally Model 19 teletypes, which are used for the perforation of tape, the typing unit being used to make a file copy of sent traffic. Receiving channels are terminated in Model 15 teletype page printers.

Multi-copies by Teletype Paper

Multiple page copies of dispatches are obtained through the use of multiple copy teletype paper, use of hecto ribbon to permit duplication by hecto methods. In the larger centers where large quantities of certain selected dispatches are required for distribution, a duplicating center is provided. Multiple copies are prepared by using page printers with multilith, hecto or mimeograph masters and processed on standard office equipment. In these cases typing reperforator tapes are used to drive the page printers used in the duplicating center.

Major relay centers employ semi-automatic tape reperforation equipment. Figure One is a typical installation. All incoming and outgoing lines terminate in switchboards, and distributing frames show at the distant end of the room.

Receiving positions are located in a row at the right hand side of the photograph. Each cabinet consists of eight typing reperforators. Sending positions are located in the next row of equipment to the left. Typing reperforator tapes are thrown off to individual message lengths and distributed by operators to the proper sending positions by inserting the leading portion of the tape in the rear of the tape grid, bearing the call letters of the specific channel upon which it is to be transmitted.

Transmitting positions on all heavily loaded circuits are provided with two transmitter distributors which are so controlled that when a message is being transmitted in one of the transmitter distributors the next tape to be sent on that channel may be inserted in the second transmitter distributor and upon completion of transmission of the first message the second message will be sent automatically.

Each duplex sending channel is provided with automatic numbering and is monitored by a typing reperforator and a continuous tape record of all transmissions retained on a tape winder. An installation of these equipments is shown in Figure 2. All reruns are effected by ultilization of the monitor tape. This may be accomplished by pulling back the tape on the reel and inserting the message in a mobile transmitter distributor mounted on a mobile table. Each transmitter position is provided with automatic numbering release button in order that wire notes and other unofficial messages may be transmitted without interference with the official number sequence utilized on the circuit.

The major problem encountered in connection with any relay station is that of handling multiple address messages. Approximately 30% of all messages handled involve two or more addressees.

This problem is handled by routing all messages requiring retransmission on more than one circuit to a tape factory shown in Figure 3. Tapes are delivered to a girl as

Fig. 3. All messages requiring retransmission on more than one circuit are routed to a tape factory, shown below.

shown in the photograph. She marks each tape indicating the first call for final transmission and each call for which a copy is to be made. She then runs off the heading on the 15-page printer and places the tape in the tape grid at a transmitting table. The transmitters are permanently wired for one, two, four, or eight copies from a single tape. The operator places the tape in the transmitter distributor, keying the number of copies required, and upon starting the transmitter the typing reperforators "manufacture" the tapes required for relay. The operator at the receiving cabinet, right background, collects the tapes together with the original from the sending table and marks the manufactured copies for final delivery to the transmitting positions in the normal manner.

Fig. 4. Multiple channel equipment . . .

Complex Equipments

The tapes are now passed through the final operator in the tape factory via the tape clips center background and checked off on the page copy heading and then placed in an outgoing position to be picked up for the final transmission out of the station. A supervisor periodically checks the page check-off copy to be sure all relays required have been made. This installation is so designed that it can be operated with any number of people from the full load assignment of four down to one during a very lightly loaded period.

The technological control center includes all multiple channel equipments and testing equipments which require operators with more than average technical skill or technicians for the lineup and maintenance of the equipment. The following multiple channel equipments are in use in naval communications stations, time division, multiplex equipment which provides four 60 w.p.m. teletype channels over a standard Navy radio teletype facility, six-channel frequency division multiplex equipment which is operated over single side band radio circuits, speech control equipment, which provides high quality circuits via single side band channels and frequency division multiplex equipment used to provide keying channels to radio transmitting and from radio receiving stations. All of these equipments require technical maintenance and are placed in the technological control area. The testing and regulating center provides in a centralized location all patching facilities and monitoring equipment to permit quality control of all circuits in and out of the communications center. Figures 4 and 5 show this installation equipment is laid out in a horse-shoe shape and basically provides the following functions:

(a) Monitoring telegraph channels by means of monitoring printers and other teletype testing equipments.

(b) Monitoring voice circuits and tone groups, adjustments being retained at the multitone equipments. Monitoring radio circuits on a limited basis.

(c) This installation also provides patching facilities for all circuits, telegraph and audio passing through the Communications Center. Each telegraph circuit, sending and receiving, is terminated in a polar relay and patching facilities are provided for checking loops on each side of the relay. All switchboards are wired normal. Telephone P. B. X. board shown in the photograph is used for patching overseas telephone trunks into the local telephone system.

Fig. 5. All of these euipments require technical maintenance and are placed in the technical control area.

NAVY LINES GO UNDERGROUND

By Lieut. H. F. Kane and Lieut. R. B. Bodenhamer

Electronics Division, Bureau of Ships

At the close of hostilities in the late conflict, the Bureau of Ships Electronics Division leaned back with a sigh of satisfaction and took a look at Naval shore radio receiving stations on a long-range basis. During the fast-moving operations of the war years there had been time only to "do the best possible, but quickly—especially quickly!"

Almost the first item to loom into view was transmission lines. For years, Naval shore radio receiving stations have employed long open-wire transmission lines to connect large directional antennas to the receivers. In the meantime, considerable progress has been made in the design of large directional antennas so that now there are broad-band, high-gain, directional antennas with nearly-flat impedance curves. Little had been done however, to improve the transmission lines used with these antennas. It was discovered that while directional antennas were being erected to receive signals down a narrow azimuthal angle, the open wire line was picking up noise from all directions all along its length.

Theoretically, a balanced open-wire line will not pick up radiations. However, experience has shown it to be nearly impossible to keep a line balanced, even when properly terminated. It was also noticed that the open-wire lines had an irresistible attraction for spiders, birds, snakes, squirrels, and numerous other members of the animal kingdom. In tropical regions, vines just love to drape themselves over poles and lines. In the arctic, icicles would much rather hang on transmission lines than on eaves, and they found it's far more fun to break insulators than to clog down spouts.

Further, during rainy, foggy, and sleety weather the impedance of the lines was found to vary all over the range. So the directivity of the antennas was first wide, then narrow, seldom constant. The lines required an excessive amount of maintenance for the results achieved. They were unwieldy, unsightly and vulnerable to sabotage and vandalism. Their erection required large crews and the shipment of materials required large cargo space. If it became necessary to move the station, the lines

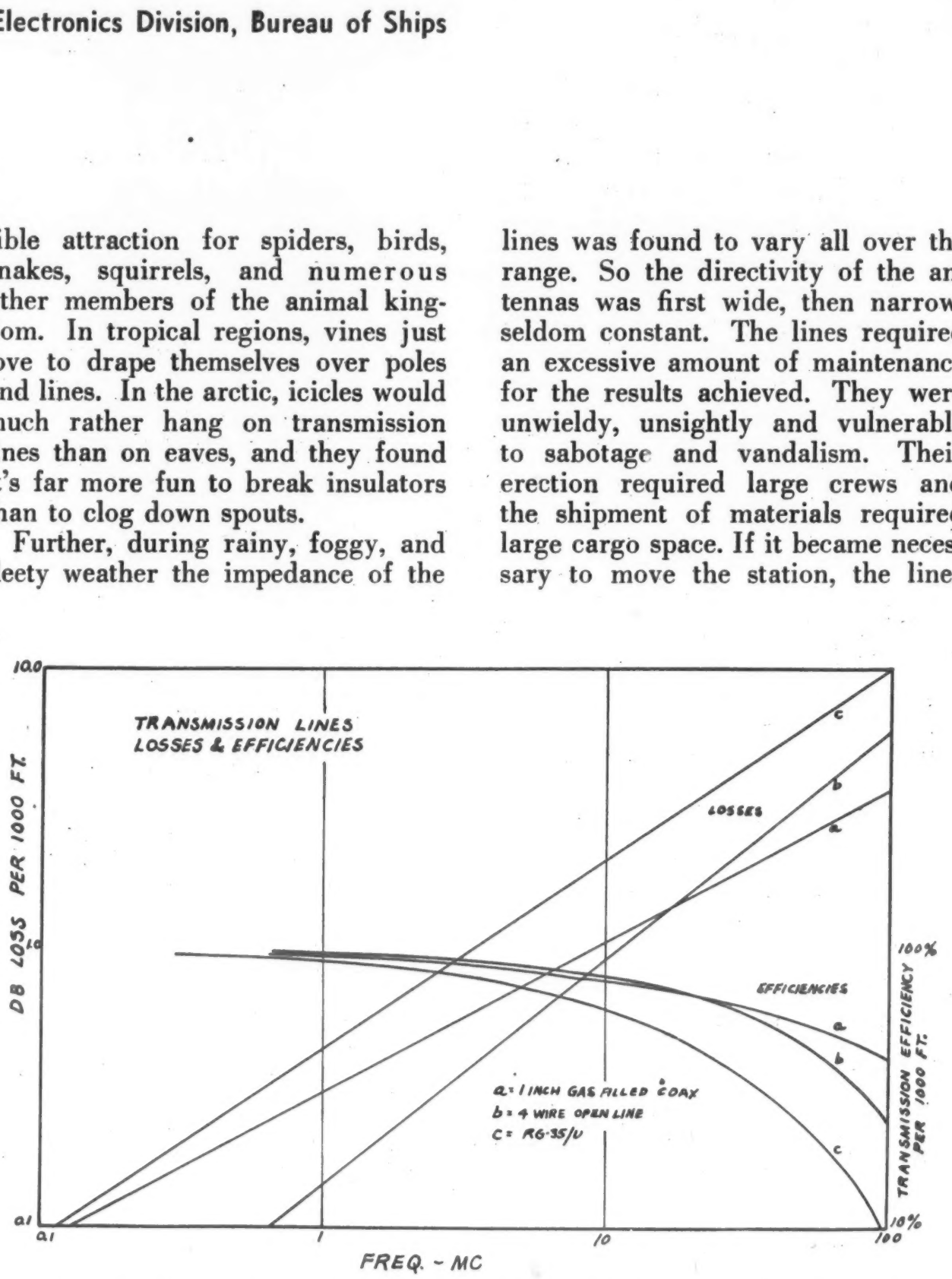


Fig. 1. Results of comparison tests between gas filled, solid dielectric coaxial line and open wire line.

were not completely salvable. It was readily apparent that a new type of transmission line was required.

A survey of the transmission line field revealed that either a gas filled or a solid dielectric coaxial line was the logical successor to the open-wire line. A comparison test between the three types of lines was conducted with the results shown in figure 1.

Lines Comparison

At first glance the gas-filled lines appear the most promising of the lot. However, all factors cannot be shown in the graph. Gas-filled coaxial lines require considerable maintenance and are not rugged enough to stand the varied conditions of service required of Navy transmission lines. Further, difficulty has been experienced in the field with poor contact at joints which requires that they be allowed to slip to care for expansion and contraction of line during temperature changes. These poor contacts caused undesirable discontinuities that in many cases were difficult to locate and correct. Though the solid dielectric cable had greater loss than either of the others, it was concluded that the signal-to-noise ratio at the receiver input would be increased by an amount greater than the difference in attenuation suffered in a line of reasonable length. The sensitive modern receivers would do the rest. Thus electronically, the comparison between solid-dielectric coaxial lines and open-wire lines was quite similar for radio reception. A look at the various cables on a physical basis disclosed that coaxial cable is unaffected by external uncontrollable factors. Hazards of fire, attack, and vandalism could be greatly reduced if a suitable cable, capable of burial, could be found. Adequate design could reduce maintenance by 95%. A transmission line on a reel would require less cargo space when shipped, a shorter time to install and would lend itself to complete salvage.

At first glance, the open-wire line would appear to be less expensive than the solid dielectric coaxial line. When the man hours of labor required to rig lines, set poles and fabricate harness for the open-wire lines are added to the cost of materials, however, the sum will exceed the cost of material and installation of solid-dielectric coaxial lines by 20% in average terrain. In many cases, where lines must be run through swampy or rocky terrain, the cost of open-wire lines will exceed the cost of coaxial lines by 50%. This fact gave added impetus to the progress of the problem.

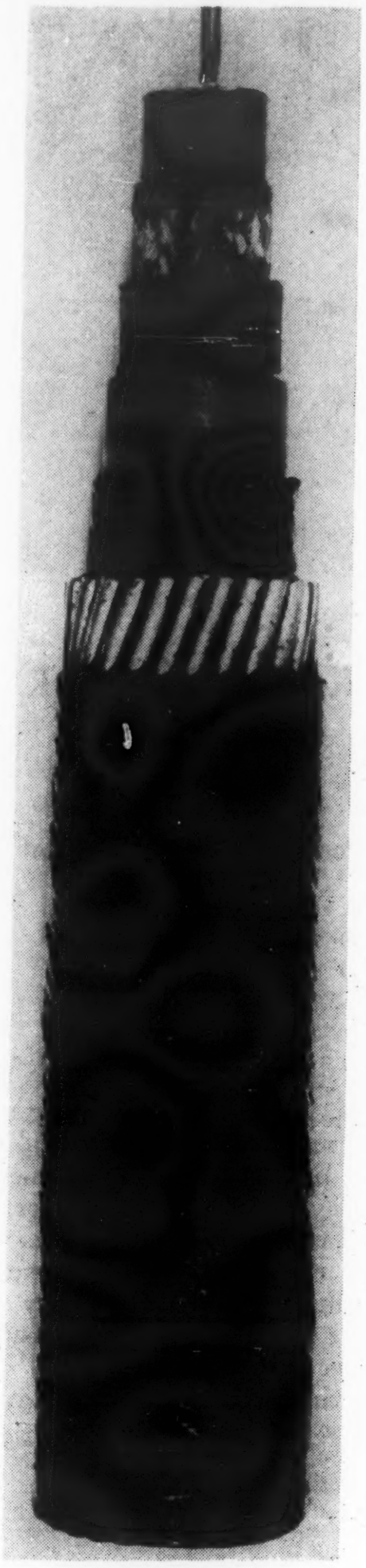


Fig. 2. The RG-85/U cable. The transmission line is RG-35/U cable. It is covered with a 1/16 inch lead jacket, a 70 pound water-proof jute serve, double galvanized number 10 BWG steel-wire armor wrap and a 16/3 impregnated jute serve with white-wash finish.

The r-f cable field was canvassed and various samples obtained. No solid-dielectric cable could be found which was completely satisfactory. This is not surprising when it is considered that the requirements included a life expectancy of 20 years while buried anywhere from a tropical tidal marsh to a frozen arctic tundra.

Ideal Line Sought

The Electronics Division of the Bureau of Ships began drawing preliminary drafts of the ideal solid dielectric coaxial transmission line for the purpose outlined. It was found that, electrically, RG-35/U cable was quite satisfactory. The problem was thus reduced to one of providing RG-35/U cable with a protective shield which would keep it secure while buried for 20 years against moisture, heat, cold, pressure, soil chemicals, gophers, insects and other detrimental factors. The cable must be reasonably flexible, capable of salvage, require no preventive maintenance and be economically suitable. Borrowing from submarine cable experience, the old standbys, lead, armor, and impregnated jute were selected as protectors.

RG-35/U Cable was covered with a 1/16-inch lead jacket, a 70-pound waterproof jute serve, a double-galvanized, #10 BWG steel-wire armor wrap and a 16/3 impregnated-jute serve with white wash finish. The resulting cable was designated type RG-85/U. See Figure 2.

An installation was made with lines connected to large directional antennas in a tropical tidal marsh and is still going strong after two years. The immediate result was a 4-db reduction in the system noise level due to the exclusion of locally-generated noise previously picked up by the open-wire lines. Considerable transmitter power would have been required to increase the signal-to-noise ratio 4-db with the open-wire lines connected to the receivers. The directivity of the antennas were improved by the more constant match achieved and maintenance costs to date have been zero. Further installations are being made at many navy stations situated in the stretch from the equator to the arctic. Reports from activities receiving the new cable are uniformly enthusiastic over

the increased efficiency of reception afforded by their buried transmission lines.

The Bureau of Ships plans to eventually convert all shore radio receiving transmission lines used with large directional antennas to solid dielectric coaxial wherever feasible. Meanwhile, efforts to improve transmission lines are continuing. The search is on to find a suitable moisture block, to act as self-sealer and thus prevent moisture creeping along the outer braid conductor of a flexible coaxial cable in event the lead jacket becomes ruptured. It is hoped that the plastics industry will eventually produce a suitable fire-resistant replacement for the outer jute serve now employed over the RG-85/U cable. The requirements for this covering are stringent. It must withstand the effects of sunlight, salt water, soil acids, age and wide temperature variations either singly or in combination.

Splicing and Terminating

Development of the above cable posed further problems of providing adequate means for splicing and terminating an r-f cable employing an outer submarine cable covering that in combination had never been attempted to the knowledge of the Navy. Basic development of these accessories was based on normal r-f cable techniques on the one hand, and the submarine cable practice on the other. These techniques were combined and improved to fit the far more difficult task of properly splicing and terminating the RG-85/U cable. The splice and termination had to maintain constant impedance and at the same time be gas tight and possess physical strength equal to the outer cable protection. Further, it was necessary to train men in the techniques of splicing and terminating a cable that was far more involved than splicing and terminating normal power, r-f or telephone cables. Without going into the details of development the following is considered pertinent information of interest. A minimum of eight man hours is allowed to perform each splice in the field by an experienced cable splicer. To assist in performing the splice a cable splicing kit, Navy type 10646, is provided which contains all the accessories and materials required for splicing the cable in the field. A completed splice up to and including the cable protector is shown in figure 3. Over this is added jute, or marlin wrapping impregnated in okonite or similar compound to complete the splice. Once completed in the prescribed manner, the splice provides the same physical strength as the actual cable and affords a gas tight barrier, and is estimated to withstand a minimum of 15 years service. In addition, no perceptible impedance variation has been detected to date.

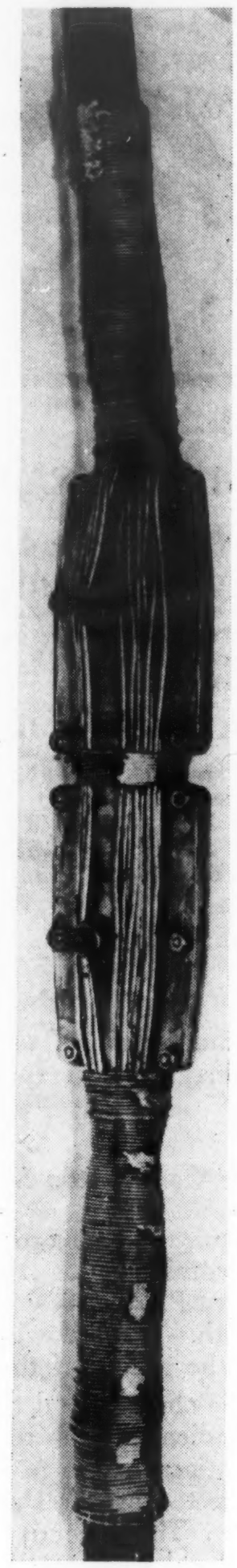


Fig. 3. Development of the RG-85/U cable presented a splicing problem. The splicing and terminating had to maintain constant impedance and at the same time be gas tight and possess physical strength equal to the outer cable protection. A completed splice up to and including the cable protector is shown above.

The connector adaptor, Navy type 491652 is utilized to terminate the RG-85/U cable at the receiver building end of cable. To this termination, smaller r-f cables possessing far more flexibility are connected for distribution of signal energy to the various receivers within the receiver building.

Gastight Seal

The end seal, Navy type 491567 is the same as the connector adaptor except for the substitution of a styramic cap to afford rigidity for the center conductor, and a terminal point for connecting to an antenna matching transformer or similar device. The transformer case is made gas-tight and provided with a "threaded boss" for securing the end seal to transformer case. A special circular gasket seated between the boss and end seal maintains the required gas-tight integrity.

An important consideration, often overlooked in the design of r-f cable accessories for outdoor use, is the gas-tight integrity that must be maintained. Unless this is provided for in the design, "breathing action" can be expected which will allow the entrance of moisture into cable and fittings, with all the associated adverse effects.

Since the obstacles presented in the design of the above cable and associated fittings, which at first seemed insurmountable, have been overcome and the cable brought into practical use, the Navy is now considering other similar developments in an endeavor to afford the ultimate in rapid communications. Among these is the design of a dual, air dielectric, balanced r-f cable having similar physical characteristics as the RG-85/U but with less electrical attenuation. Only through the continued diligent efforts on the part of the Navy and manufacturers is it possible to realize the crystallization and achievement of facilities that are required for today's and tomorrow's communications. Communications—the Nerves of the Nation and the Navy!

ASSOCIATION AFFAIRS

ARMED FORCES COMMUNICATIONS ASSOCIATION

1624 I Street, N. W., at Connecticut Ave., Washington 6, D. C.

OFFICERS AND DIRECTORS

President: **David Sarnoff**
1st Vice-Pres.: **Wm. J. Halligan**
2nd Vice-Pres.: **Darryl F. Zanuck**
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Charles E. Saltzman (1951)
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Navy to Sponsor AFCA Meeting

In a recent letter to President Sarnoff of AFCA, the Secretary of the Navy stated that "the Navy Department will indeed be pleased to sponsor your next annual meeting, presumably in late April or early May 1949. ... Norfolk, Virginia, Washington, D. C., and New York City seem to be the best possible locations. . . . All factors considered, Washington appears to offer the best location, with side trips possible to Patuxent and Annapolis. . . . The Chief of Public Relations and the Chief of Naval Communications will coordinate this project to insure a successful annual meeting for the Armed Forces Communications Association with Navy sponsorship. They will obtain the active support of representatives of various Naval Bureaus, Offices, Laboratories and other Naval activities concerned. General S. H. Sherrill will be kept advised concerning progress."

On September 9th, the Executive Secretary, after a meeting with Admiral Stone, Chief of Naval Communications, conferred with him and Rear Admiral Ewen, Chief of Naval Public Relations, Capt. Robert Foley and other members of their staffs, and with Mr. Frederick G. Macarow and Col. E. C. Cover, President and Secretary of the Washington Chapter, at a meeting arranged to make the initial plans for next spring's convention.

Executive Committee Meeting

The regular meeting of the Executive Committee was held at 30 Rockefeller Plaza, New York, on August 16th. The following extracts are from the report of the meeting:

Only one chapter, and that a small one, has indicated a desire to process renewal notices, a change in our procedure directed at our Dayton meeting in May. The Executive Secretary reported that he had, since June 1st, completely changed administrative procedures at National Headquarters to permit chapters to handle these mailings if they desire and otherwise for National Headquarters to continue to mail them.

T. S. Gary, Chicago, was selected as the director at large to serve as a member of the Executive Committee for one year beginning September 1, 1948, succeeding W. C. Henry, Ohio.

The Executive Secretary explained the item of $250.00 on the budget for prizes as follows:

ROTC summer camp award..	$ 50.00
ROTC college awards.....	75.00
ROTC prize essay to be published in SIGNALS.....	25.00
Awards to cadets, USMA, and midshipmen, USNA....	100.00

The Executive Secretary explained what action had been taken to publicize the existence of AFCA and suggested that General Sarnoff consider a brief talk over a nation-wide radio hook-up in the fall, as the president of the Air Force Association had done in August.

A special life member rate of $50.00 for enlisted men and students before graduation was voted. The rate for all others continues at $100.00.

The meeting adjourned to meet in November or December, probably at Chicago, Washington, or Philadelphia.

Reorganization

After our Board of Directors voted to authorize local chapters to handle renewals under the new $5 rate, it became necessary for national headquarters to change entirely the administrative procedures in effect previously. This has required our small office force, for most of May and all of June and July, to devote their major efforts to the reorganization. We have set up a new administrative system taking handling of renewal mailings away from our printer and placing it in our own circulation department. More effective renewal procedures are expected to result—

National Advisory Committee Chairmen

GENERAL MANUFACTURING: Mr. Fred R. Lack, V. Pres., Radio Division, Western Electric Company, New York City

BATTERY MANUFACTURING: Dr. George W. Vinal, Bureau of Standards, Washington, D. C.

DRY BATTERY SUBCOM.: Mr. Ralph E. Ramsay, V. Pres. & Research Director, Ray-O-Vac Company, Madison, Wisconsin

STORAGE BATTERY SUBCOM.: Mr. L. E. Wells, Chief Engineer, Willard Storage Battery Company, Cleveland 1, Ohio

RADIO MANUFACTURING: Mr. Fred R. Lack, V. Pres., Radio Division, Western Electric Company, New York City

TELEGRAPH EQPT. MFG.: Colonel Julian Z. Millar, The Western Union Telegraph Company, New York City

TELEPHONE EQPT. MFG.: Mr. C. D. Manning, V. Pres., Kellogg Switchboard & Supply Company, Chicago, Illinois

COMPONENTS MFG.: Mr. R. C. Ellis, V. Pres., Raytheon Manufacturing Company, Waltham, Masachusetts

PHOTOGRAPHIC EQPT. MFG.: Mr. H. A. Schumacher, V. Pres., Graflex, Inc., Rochester, N. Y.

RADAR: Mr. George F. Metcalf, Manager, Electronics Laboratory, General Electric Company, Syracuse, N. Y.

WIRE MANUFACTURING: Mr. H. Donn Keresey, Pres., Anaconda Wire & Cable Co., New York City

PUBLICITY: Mr. Orrin Dunlap, Jr., RCA, 30 Rockefeller Plaza, New York 20, N. Y.

MILITARY TRAINING: Major Gen. G. L. Van Deusen, Pres., RCA Institutes, Inc., 340 West 4th St., New York 13, N. Y.

and with not much additional work by our staff.

New Directors and Officers

The constitution has been amended so that the national president and the vice presidents must be elected each year. Our council is preparing a slate which will appear probably in November SIGNALS. If you have any names to suggest, please submit them to the Executive Secretary, for consideration by the nominating committee, before November 10th. The same is true of nominations for members of our Board of Directors to succeed those whose terms expire in 1949.

The Council

Chapters should hold elections to choose members of the national council on the basis of one for each 100 members of the chapter. These will take office on January 1, 1949, for one year. Please submit to national headquarters the names of members chosen by January 5, 1949.

Conduct of Chapter Business

The standard work to guide you in conducting business in deliberative assemblies, such as chapter meetings, directors' and committees meetings, etc., is "Robert's Rules of Order, Revised." Written originally by General H. M. Robert, U. S. Army, it is based on the rules and practices of the United States Congress but is adapted to the use of ordinary societies. It is on sale by our Book Department for $2.10.

Special Letters

Bi-monthly letters reporting developments in Association activities and in the rearmament program are being sent to each chapter president and to our group members.

Signals

It is your magazine and we try to make it a balanced publication with articles that will be of interest and value to all its readers. We receive most of the technical journals on communications and photography and our staff studies them. We hesitate to republish articles from them for fear that SIGNALS may become too technical and not interest the majority of our readers. Will you tell us whether you would like us to include more or fewer technical articles? And if you have a story to publish, please send it along. We want more contributions so that we may constantly improve our magazine from wider selections.

Publicity Committee

Orrin E. Dunlap, Jr., Navy veteran of World War I, Vice President in Charge of Advertising and Publicity for RCA, and author of a book entitled "Radar," reviewed elsewhere in this issue, has been designated Chairman of our National Advisory Committee on Publicity.

"Ham" Organization

Lt. Col. George R. Call of Sioux City, Iowa, appointed last May as chairman of the committee to study the possibility of radio "hams" being better organized for an emergency, has submitted his first report and has made two visits to Washington to gather necessary information. On August 25th and 27th, he conferred with the Executive Secretary and with officials of the Army, Navy and Air Force.

Vulliamy

On July 21st, the Executive Secretary held a conference with Maj. General C. H. H. Vulliamy, CBE, DSO, Chief Signal Officer of British Signals, at the Pentagon. General Vulliamy requested a detailed description of the organization of AFCA and its purposes for consideration by the British with a view to possible changes in the objectives and activities of the Royal Signal Association.

Invitation

National Headquarters has been at the new location on Eye Street, across

from the Army-Navy Club, for six months. now. Many of our members find it convenient to stop in and visit when in Washington and to use our address for their mail during their stay in the capital. You are cordially invited to stop in and give us your suggestions for a better association, or register your complaints if you have any.

New Group Members

American Phenolic Corporation, Chicago, Ill.

Bliley Electric Company, Erie, Pa.

Cinch Manufacturing Corporation, Chicago, Ill.

Gilfillan Bros., Inc., Los Angeles, Cal.

Hoffman Radio Corporation, Los Angeles, Cal.

National Fabricated Products, Inc., Chicago, Ill.

O'Keefe & Merritt Company, Los Angeles, Cal.

Sonotone Corporation, Elmsford, N. Y.

United Radio Television Institute, Newark, N. J.

Wm. H. Welsh Co., Inc., Chicago, Ill.

Wollensak Optical Company, Rochester, N. Y.

War College

The third session of the National War College in Washington began August 30th with a class of 90 officers of the Armed Forces and 20 key civilians from government departments. The National War College is the top school in the Armed Forces educational system and is the successor to the Army War College which operated for nearly 40 years until World War II. Selection to attend the college is a high honor and goes only to specially selected officers. The civilians come from the State and Treasury Departments, the Bureau of the Budget and the Central Intelligence Agency. Communications officers selected to attend were: Col. R. C. Maude of the Air Force and Colonels Samuel P. Collins and James S. Willis of the Signal Corps—all members of AFCA.

CCAFA

The first fall meeting of the Coordinating Committee, Armed Forces Associations, met at the Army-Navy Club on September 21st. The principal item discussed was the Industry-Army Day meeting which in 1947 was held at Chicago and in 1948 at Dallas. Announcement of the place and time of this year's meeting is expected to be made soon.

Guests at the meeting were the Public Relations Chiefs of the National Military Establishment, Mr. Harold Hinton of Secretary Forrestal's office, Rear Admiral E. C. Ewen, Maj. General Bryant E. Moore, USA, and Mr. Stephen Leo, USAF.

National Guard Administration

A program to relieve National Guard administrative duties and permit them to concentrate on the primary mission of preparing their units for their defense assignments was announced recently by Major General Kenneth F. Cramer, Chief, National Guard Bureau.

Under the program as authorized by the Military Appropriations Act for 1949, officers and enlisted men of the National Guard will be appointed as civilian administrative assistants to the commanders of the National Guard units. As such, they will be responsible for all administrative matters, including the heavy load of "paper work" and otherwise assist their unit commanders.

Although on a civilian pay status, the administrative assistants must be members of the National Guard, ranking in the first three grades for enlisted men and from first lieutenant to lieutenant colonel, inclusive, for officers. They will be employed either full-time or part-time as immediately necessary, at authorized yearly salaries within the limits set by the National Guard Bureau from funds appropriated by Congress.

Ellis Heads NSRB Committee

A new task committee to review the World War II control and limitation orders of the former WPB Radio and Radar Division was organized in mid-September by Leighton H. Peebles, Chief of the Communications and Utilities Divisions of the National Security Resources Board. Ray C. Ellis, Executive Vice President of the Raytheon Manufacturing Company, and the Chairman of AFCA's Components Manufacturing Advisory Committee, has accepted the chairmanship of the task committee. Other members of the task committee will be from RCA Victor Division, Executive Vice President Frank M. Folsom, or an alternate; Motorola, Inc., with President Paul V. Galvin contacted; Philco Corp., with President John Ballantyne being asked to name a representative; and the International Resistance Co., with Vice President Harry A. Ehle to represent the components manufacturers.

The NSRB electronics-radio task committee will submit its recommendations to the Electronics Manufacturing Industry Advisory Committee which is being appointed to serve both the Munitions Board and the NSRB. This reporting to the industry advisory committee follows the same plan formulated by Mr. Peebles in the case of the review of WPB orders by the telephone and telegraph task committee.

Reorganization Act

The administrative organization and procedure for carrying out the Renegotiation Act of 1948 are outlined in a directive announced by Secretary of Defense James Forrestal.

The directive provides for a top board, to be established in the Office of the Secretary of Defense and to report to him through the Munitions Board, which will be called the Military Renegotiation Policy and Review Board. In addition, there will be an operating board, to be known as the Armed Services Renegotiation Board, which will be a joint board of the Army, Navy and Air Force, and will operate through divisions in each of those three departments.

Secretary Forrestal's directive was based upon recommendations submitted to him by the Munitions Board and by an ad hoc committee composed of Under Secretary of the Navy Kenny, Under Secretary of the Air Force Barrows, and Assistant Secretary of the Army, Gray. The ad hoc committee, before submitting its recommendations, conducted extensive consultations with persons who had broad experience in the field of renegotiation of military contracts in World War II.

A tentative draft of renegotiation regulations has been prepared by the ad hoc committee, but it will be some time before the regulations can be issued. The members of the Military Renegotiation Policy and Review Board have not yet been named. When the board has been appointed, it will review the tentative draft of regulations, and will conduct additional discussions with industrial representatives, including industrial associations. A final draft of the regulations will then be submitted to Secretary Forrestal by the board.

(Editor's Note: AFCA has been requested to study the draft and has sent copies to certain chapters for study and recommendations.)

Chapter News

☆ ☆ ☆ ☆ ☆ **Chapter Of The Year, 1948 — Far East, George I. Back, President** ☆ ☆ ☆ ☆ ☆

CHAPTERS AND SECRETARIES

ATLANTA: Maj. Peter J. Ryan, Hqs. 3rd Army, Ft. McPherson, Ga.

BALTIMORE: Col. Walter J. Rosengren, Baltimore Signal Depot, Middle River, Md.

BOSTON: Capt. F. P. Singleton, Boston Army Base, Boston 10, Mass.

CHICAGO: Col. Raymond K. Fried, 111 W. Monroe St., Chicago 3, Ill.

CLEVELAND: H. E. Schafer, Radiart Corp., 3751 W. 62nd St., Cleveland 2, Ohio.

DALLAS: E. H. Mittanck, Rm. 816, Telephone Bldg., Dallas, Tex.

DAYTON: Gertrude A. Knight, 54 Patterson Village Dr., Dayton, Ohio.

DECATUR: E. C. Whitcomb, RR 6, Box 263, Decatur, Ill.

EUROPEAN: William M. Hart, ICD, OMGH, c/o Radio Frankfurt, APO 757, New York, N. Y.

FAR EAST: Maj. C. B. Whittenberg, Sig. Sec., GHQ., FEC, APO 500, c/o PM, San Francisco, Calif.

FORT MONMOUTH: Col. William L. Seibert, Squier Signal Laboratory, Fort Monmouth, N. J.

KENTUCKY: Capt. John A. Short, Lexington Signal Depot, Lexington, Ky.

NEW YORK: Col. William H. Harrington, 795 Broadway, New York, 757, New York, N. Y.

OGDEN-SALT LAKE: Miss Marjorie Hansen, 2227 Adams Ave, Ogden, Utah.

PHILADELPHIA: Joseph Bergman, Sig. Corps Stock Control Agency, 2800 So. 20th St., Philadelphia, Pa.

PITTSBURGH: Capt. J. J. McGovern, Bell Telephone Co., 229 Spahr St., Pittsburgh 6, Pa.

RICHMOND: Lelia Sussell, Ches. & Potomac Tel. Co., 703 E. Grace St., Richmond, Va.

RIO: Maj. Huston Maxwell, JBUSMC, APO 676, % Pm, Miami, Fla.

SACRAMENTO: Lt. Col. George H. Melvin, Jr., Sacramento Signal Depot, Sacramento, Calif.

SAN FRANCISCO: Capt. John H. Meyer, 1930 Prince St., Berkeley, Calif.

ST. LOUIS: Capt. Henry C. Hughes, 319 No. 4th St., St. Louis 2, Mo.

SEATTLE: Capt. Lawrence W. Bucy, Alaska Communication System, Seattle 4, Wash.

SPANISH WAR VETERANS DIVISION: George A. Marshall, Adj., 215 Montague St., Brooklyn, N. Y.

WASHINGTON: Col. Edward C. Cover, Chesapeake & Potomac Tel. Co., 725 - 13th Street, N. W., Washington, D. C.

STUDENT CHAPTERS

CORNELL: John M. Ross, 126 McFaddin Hall, Ithaca, N. Y.

NEW YORK UNIVERSITY: Robert D. Hawkins, 25 Spruce Ave., Ridgefield Park, N. J.

OKLAHOMA A & M: W. L. Covel, Mil. Dept., Okla. A & M College, Stillwater, Okla.

STATE COLLEGE OF WASHINGTON: Stuart W. McElhenny, 604 California St., Pullman, Wash.

TEXAS TECH: T. L. Timmons, 2012 8th St., Lubbock, Texas.

UNIVERSITY OF CALIFORNIA: R. G. Barhite, Bowles Hall, U. of Calif., Berkeley, Calif.

NATIONAL HEADQUARTERS CHAPTERS SECRETARY: JULIA B. GODFREY

Chapter of the Year

The European Chapter is publishing a printed bulletin, illustrated and with the cover in color, which, together with a current drive for increased membership, puts them in the lead for the 1949 "Chapter of the Year" award. Data is being compiled at national headquarters from membership records and chapter reports. In May 1949, a committee will study the data and select the winner.

Points will be earned on the following basis:

(a) Each meeting held by a chapter from May 1, 1948 to April 30, 1949—1 point. (Example: A chapter which held one meeting per month during this period would earn 12 points.

(b) The percentage of active members present at each meeting, times the number of meetings. (Example: A chapter which had 40% of its members present at each of these meetings would earn 12 times .40, or 4.80 points.)

(c) The percentage of active strength of the chapter as of May 1, 1948, that has been added in new members, times 5. (Example: A chapter which on May 1, 1948, had 100 members and by April 30, 1949, had added 50 new members, would have a percentage of 50% and would earn .50 times 5, or 2.50 points.)

(d) The percentage of renewals from May 1, 1948, to April 30, 1949, times 10. (Example: A chapter having 500 active members on May 1, 1948, of which 100 renewed during the period indicated, would have a percentage of 20% and would earn .20 times 10, or 2 points.)

Perfect score for a chapter that had a meeting each month during this period, perfect attendance at each meeting, and doubled its membership, would be 39 points.

In addition to the above, the committee of judges will consider and give proper weight to such activities as type of programs presented at meetings; chapter publications—their character and content; action taken to increase interest in military preparedness, such as the awarding of chapter prizes to students or members of military establishments, etc.; and completeness of reports of chapter activities sent to national headquarters.

Baltimore

The Baltimore Chapter Secretary's annual report on activities was received at national headquarters in July. The Executive Secretary was so impressed with the excellence of the report that he asked its author, Col. Arthur Pulsifer, to send a copy to each of the other chapters. The chapter showed a 36% increase in membership, although less emphasis was placed on a membership drive than on the preparation of interesting programs. Meetings featured the following guest speakers: Lt. Gen. Leslie R. Groves, Chief of the "Manhattan" Atom Bomb Project; Lt. Gen. Leonard T. Gerow, Commanding General of the Second Army; Capt. Robert Foley, Office of the Chief of Naval Communications; and

Mr. E. K. Jett of the Baltimore Sunpapers and Vice President of AFCA. Other activities included a guided tour through the Westinghouse Baltimore plant and a visit to the Naval radio station at Annapolis. The chapter treasury showed a balance of $90.78; with the exception of $26.72 received from national headquarters, all of this was raised locally.

European

On August 14th, 168 members and guests of the European Chapter boarded the yacht "Gutenberg" at Frankfurt and attended the second quarterly meeting of the chapter, which was combined with an eight hour cruise of the Main and Rhine Rivers. Major General Jerry V. Matejka, Chief Signal Officer, EUCOM, addressed the members and commended the progress being made by the chapter.

An European Advisory Committee, to represent the three services, was appointed as follows: Col. R. W. Raynsford, Army; Col. D. C. G. Schlenker, Air Force; and Commander R. B. McCurdy, Navy. Representation on the Membership Committee was extended to include the Air Force; OCSigO, EUCOM; Frankfurt Signal Office; Constabulary; 1st Division and the Navy. It was decided to extend guest membership in the European Chapter to Generals Clay, LeMay, Keyes, Milburn, Huebner, White; Admiral Schuirmann; Ambassadors Murphy and Erhart; and the Post Commanders and Commanding Officer of the Naval Advance Base at Bremerhaven.

Los Angeles

The initial meeting to form a Southern California Chapter of AFCA will be held on October 15th at 8 P.M. at KMPC Studio A, 5939 Sunset Blvd., Los Angeles. The meeting will be preceded by a dinner at the Palms Grill, 5931 Hollywood Blvd. The main speaker will be Capt. Harry C. Butcher, Naval Aide to General Eisenhower and author of the book, "My Three Years with General Eisenhower." Those wishing to make dinner reservations should call Lt. Col. Loyd Sigmon at KMPC—Hollywood 5341.

Richmond

Officers and committee chairmen of the Richmond Chapter met on September 9th to formulate plans for fall activities. The first dinner meeting of the chapter will be held on October 13th. General S. H. Sherrill, National Executive Secretary, will come down from Washington to address the members.

Sacramento

The Board of Directors of the Sacramento Chapter met on August 25th at the Sutter Club. Present were: Lt. Col. Wesley E. Calkins, McClellan Field, Air Force Counsel; Milton G. Mauer. Div. of Commercial Engineers, PT&T; Paul Carrington, PG&E; Robert D. Livingston, President, Junior Chamber of Commerce; George H. Brereton, Chief, State Div. of Identification; Waldeman E. Doyal, Sierra Camera Club; George H. Melvin, Executive Secretary, Sacramento Chapter; and H. M. Skidmore, Public Information Officer, Sacramento Signal Depot. Col. Stewart W. Stanley, Commanding Officer of the Sacramento Signal Depot, who attended as a special guest, was appointed Signal Corps Counsel for the Chapter.

The president opened the meeting by introducing Col. Stanley, who accepted the office of counsel. Col. Stanley was enthusiastically received and in a brief talk complimented the chapter and particularly the officers and Board of Directors on their past activities. He mentioned having discussed the chapter at some length with General Sherrill, Executive Secretary.

Mr. Brundige then reviewed chapter activity since it was organized in 1946 and paid particular tribute to Col. A. M. Shearer who had served the first year as acting president and thereafter as Signal Corps counsel. Col. Stanley suggested that a resolution might be passed by the Board expressing the appreciation of the chapter to Col. Shearer for his leadership and material assistance. A vote was taken and it was unanimously decided that such a resolution should be prepared and mailed to Col. Shearer, who is now in Washington as Asst. Chief of the Procurement and Distribution Division, OCSigO.

Col. Charles W. Sheeley, active in the Signal Corps Reserve, has agreed to act as temporary chairman of the new chapter's board of directors.

Seattle

The Seattle Chapter held a dinner meeting on August 5th at the American Legion Hall. The speakers were Col. Fred Andrews, former Commanding Officer of the Alaska Communication System, and Major Joyce B. James of ACS. The feature of the evening was a talk and demonstration on Micro Wave Phenomena presented by Mr. J. Key, Demonstration Supervisor of the Pacific Telephone & Telegraph Company.

Spanish War Veterans Division

The officers of the Spanish War Division of the U. S. Veterans Signal Corps Association have accepted an invitation to become an honorary division of AFCA. The U. S. Veterans Signal Corps Association was organized by Signal Corps veterans of the Civil War in 1867. The Civil War Division was disbanded in 1919 and the Association has been continued in existence by the Spanish War Division, which was organized in 1899.

There are some 300 members of this Association throughout the United States, of whom about thirty attended the annual encampment of the United Spanish War Veterans in Washington, August 22nd to 26th. At the Veterans luncheon at the Hotel Hamilton on August 24th, John White of Dallas, Past Commander, United Spanish War Veterans, was the principal speaker. Col. E. C. Cover, Secretary of the Washington Chapter of AFCA, spoke concerning the activities of his chapter, and Brig. Gen. S. H. Sherrill, Executive Secretary of AFCA, addressed the delegates, outlining the aims and purposes of AFCA, and extended the invitation for the Spanish War Signal Corps Veterans to become an honorary division. Officers of the Spanish War Veterans Division, AFCA, were elected as follows: Asa T. Pierce. Commander, and George A. Marshall, Adjutant.

Washington

Washington Chapter activities for the fall and winter will open with a communications industry sponsored buffet supper-meeting October 22nd. A scientist from a leading industrial electronics laboratory has been invited as the principal speaker for the meeting.

The supper-meeting is the first of several activities which were scheduled for the near future during a meeting of the chapter's officers and committee chairmen September 17th.

Navy Day Message to Radio Amateurs From the Chief of Naval Communications, Adm. Earl E. Stone

For many years on Navy Day the Secretary of the Navy has directed a special message to radio amateurs through the facilities of Navy radio stations at Washington and San Francisco. This year, in addition to the message from the Secretary of the Navy, the Navy Department is sponsoring a Navy Day QSO party which will be devoted to contacts between amateurs who are members of the Naval Reserve and those who are not. Remember the date—Navy Day, October 27th.

Many amateurs came into the Navy, both as officers and as enlisted men, during World War II. To them we owe a great deal for their contributions to the successes which the Navy, and the other services, attained during that war.

The amateurs who entered the Naval service had previously, through their devotion to amateur radio, developed into good CW operators and good radio technicians, and were able to fill important billets immediately upon mobilization, often without any additional training. The Navy's communication and electronics requirements upon mobilization were literally beyond normal expectations. The fine training which so many amateurs had voluntarily given themselves proved invaluable to the military services, especially during the mobilization period before our wartime training programs could become effective.

The enormous strides which have been made in the development of communication material—the development of various mechanical means of transmission and reception, and of voice transmission and reception—have had a tendency to produce radio personnel who may be inclined to underestimate the importance of certain fundamentals. Today, if you have the money, it is easy to purchase radio transmitters and receivers complete. But the young amateur of today may fail to learn much that is fundamental if he passes up the opportunity of assembling his own equipment—not to mention the thrill that goes with building your own radio facilities. The newcomer in the amateur field will do well to follow in the footsteps of his older brother and learn by cutting and trying. The know-how which the amateur acquires by personally testing and experimenting is the priceless ingredient that makes the amateur the v itally important man in an emergency. Know-how coupled with resourcefulness has frequently meant success when success was urgently required.

The Navy still considers CW operation to be the fundamental requirement of a radio operator. No matter how mechanized and automatic communications may become we shall always need manual and voice operators (brass pounders and radio telephone technicians) when the going is toughest. As one of my officers in Washington recently put the same thought—'The Phi Beta Kappa Key boys will always be deserving of much praise for their various accomplishments, but in military communications the 'Tap-a-Key' and 'Cock-an-Ear' boys are the ones who really deserve a pat on the back."

A quick glance at a recent issue of the amateur call book reveals that there are more radio amateurs at the present time than ever before. This is a healthy and most welcome condition. I recommend that everything practicable be done to sustain this newly aroused interest. Because the increase in the number of licensed amateurs demands the greatest efficiency in utilization of available amateur frequency allocations the use of CW radio telegraphy should be encouraged. The reasons for this are that:

(1) More channels per kilocycle of spectrum can thus be obtained; and what is more important (2) amateur bands are rendered less vulnerable to reduction by reason of inefficient use, and (3) from the military viewpoint, more trained CW operators will be available to the services in an emergency.

We have a list of about 8500 licensed amateurs who were in the Naval service either as officers or enlisted men during the war. I have talked with many officers who were charged with important Navy communication projects during the war, and I have had some experience myself in connection with advance base communication planning, construction, and installation work in the far Pacific. Usually on each project we had a very few experienced Navy regulars plus many hands to do the pick and shovel work. Fortunately there were usually some amateurs or other experienced men present, and often it was their know-how and self-starter characteristics that made the project successful. Therefore I naturally encourage and support the amateurs since I know first hand how essential they are to our national security and defense.

Navy communication facilities are netted into world-wide nets of several descriptions—radio, landwire, radioteletype, wire and radiophoto nets. In fact every conceivable method of modern communications is utilized. Of course, in peacetime we cannot maintain as extensive a communication system as we require in war. Accordingly we must be ready to expand quickly from peacetime to wartime requirements—both in personnel and materiel.

Continuous research is being conducted to devise faster and more reliable means of communication to improve the systems we now have. For as the tempo of modern warfare increases, with faster ships and faster airplanes, so must the speed of communications be increased, in order that command may be exercised promptly and effectively in directing and controlling the movements and action of our military forces. Besides being fast, military communications must be kept flexible. We are apt to be called upon to furnish communications in support of various kinds of operations and command assignments, requiring speedy implementation.

We are constantly trying to integrate the Naval communication system with those of the Army and the Air Force in order to achieve better preparedness and greater economy of men, material, and frequencies. This integration of the three services' communications will be acomplished without depriving any one of the services of its own communications, so essential for the effective exercise of military command.

It is with great pleasure that I bring this message, for the Navy, to the radio amateurs of America. You have a truly great record of accomplishment. You have been responsible for so much in the development of electronics and communications. Your performance of duty, both in peacetime emergencies and in war, has been of the highest order. I know that individually and collectively you will always support and maintain the splendid record which you have firmly established as patriotic American amateurs. I bring you the Navy's highest praise.

PERSHING

1860-1948

GENERAL OF THE ARMIES WASHINGTON TO GENERAL OF THE ARMIES PERSHING

Cadet Pershing

1st Lieutenant

Capt. Pershing with a Japanese officer, as a U. S. Military observer during Russo-Jap War

Gen. Pershing in France, World War I, accompanied by Col. George C. Marshall, his aide.

The death and burial in Washington in July of John J. Pershing focused attention on the astonishing career of the man thought by many to be America's greatest commander and soldier. Born as the great "war between the States" was on the horizon in 1860 his life spanned the period from Indian wars to the atomic bomb. Perhaps there could be no better illustration of the democracy of the Army and of the service academies than Pershing's success as a cadet at USMA. No cadet could have entered the Academy with less influence than this oldest of nine children, born in the humble home of a railroad section hand at La Clede, Mo. Nevertheless, on sheer ability alone he was chosen to be First Captain of the Corps of Cadets—an honor that he is said to have considered the most satisfying of any in his entire career. After that, he was always a leader—fighting in our war with Spain, against the Indians in the west and against the Moros in the Philippines, then in the Villa campaign in Mexico and finally as Commander in Chief in World War I in Europe. His influence in military matters in the U. S. continued to grow. There could be no question but that his vision and his efforts resulted in the modern powerful Army of the U. S. of World War II. His influence guided our armies from his retirement as Chief of Staff at least until the selection of his former aide, General G. C. Marshall to be Chief of Staff in World War II.

He exemplified the well-known virtues of his professional tradition—absolute fearlessness, unimpeachable honor, subordination of ambition to duty. And he looked the part, with his military carriage and manner of one born to command. One of his best known qualities was that of exactness in planning. He would have admired the perfection of the plans for his funeral here in the Nation's capitol. Not a single detail was overlooked from the time that General Beach, the Commander at Walter Reed reported General Pershing's death personally to President Truman, until the marble headstone with "John J. Pershing" and the date of his birth and death cut in the stone was set in place at the green-sodded grave the day after the funeral. The six perfectly matched grey horses which pulled the caisson bearing the general's body from the capitol to Arlington were part of a final act in the Army which for so many years had found horses and animals essential to warfare. It is not likely that military funerals will ever again follow this old tradition. It marked this great soldier's "crossing over the river to rest under the shade of the trees"—with the immortals—Washington, Grant, Lee, Jackson.

The famous "Lafayette, we are here" day. Arriving in France.

Arlington, July 19th, 1948. General of the Armies, John J. Pershing, goes to rest at the site chosen by himself, close to many who served under him.

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NEWS—SERVICES and INDUSTRY

General

RMA Mobilization Plan

After weeks of discussion with leading officials of the armed services who are charged specifically with the procurement of radio-electronic equipment, the Radio Manufacturers Association Industry Mobilization Policy Committee has officially presented to the top level leadership of the Munitions Board the RMA plan for spreading military procurement contracts throughout the radio-electronic manufacturing industry.

The formal presentation was made to Lt. Gen. LeRoy Lutes, Deputy Chairman of the Munitions Board executive committee, and other Board members by two leading members of the RMA Industry Mobilization Policy Committee, President W. A. MacDonald of Hazeltine Electronics Corp. and Executive Vice President Frank M. Folsom of the RCA Victor Division, who directed during World War II the procurement policy program for the Navy. RMA Committee Chairman Fred R. Lack, Vice President in charge of radio manufacturing of the Western Electric Co., was in Canada and was unable to be present for the session. A number of top Munitions Board and other officials of the armed services, directly concerned with radio-electronic procurement and supply, were present at the session when Mr. MacDanald and Mr. Folsom presented the RMA plan to General Lutes.

The communications and electronic committee of the Munitions Board, which is headed by Colonel Fred Kunesh of the Army Signal Corps, appointed a four-member subcommittee to study the RMA mobilization plan and the subcommittee has submitted a tentative report on the RMA plan.

In the proposal to establish advisory industry committees to the Munitions Board, it has been rather well determined that the first such body to be selected will be the Electronic Industries Advisory Committee. The NSRB through Communications Consultant Chief Leighton H. Peebles is one of the strong supporters of the idea of avoiding too many duplicating advisory bodies from industry so as to waste the time of the top industry executives.

Draft Call Control

Designation of the Munitions Board as liaison for the National Military Establishment with the Selective Service System in matters pertaining to manpower requirements of the three military departments has been announced by Secretary of Defense James Forrestal.

Its authority in these matters will include not only transmission of calls and quotas for inductions under the Selective Service Act, but it also will handle requests for deferment of civilians employed in the Military Establishment.

With regard to requests for deferment for induction of civilians employed in critical occupations of the Military Establishment, Secretary Forrestal's memorandum directs the Munitions Board to establish policies concerning individuals or categories of persons, "whose employment, occupation, or service, or activity in study, research, or other endeavors is considered to be necessary to the maintenance of the national health, safety, or interest."

The Munitions Board also is directed to present requests for such deferments to the Selective Service System and to take "such appellate action as may be considered advisable in the event of denial for such requests for deferment."

Research Board

Dr. M. J. Kelly, Executive Vice President of the Bell Telephone Laboratories, has been named Chairman of the newly-constituted Committee on Navigation formed by the Research and Development Board after a study of overall problems related to land, marine and air-navigation.

The appointment of a three-member Common Carrier Communications Advisory Panel was announced recently by Russell J. Hopley, Director of Civil Defense Planning. The members are Clyde S. Bailey, Executive Vice President of the United States Independent Telephone Association; C. M. Brown, Director of Plans and Methods of the Western Union Company, and J. B. Rees, Assistant Chief Engineer, American Telephone and Telegraph Company.

Budlong Sec-Mgr of ARRL

A. L. Budlong, Senior Assistant Secretary of the American Radio Relay League, who has been associated in an executive and technical capacity with the league since 1924 and who established a distinguished record with the U. S. Coast Guard during World War II, particularly in allocation planning for national and international communications, was designated acting secretary and manager of the league Sept. 6 to succeed the late Kenneth B. Warner who died Sept. 2 from a heart attack.

The appointment of Mr. Budlong was made at a special meeting of the ARRL executive committee at the national convention of the league in Milwaukee on Labor Day.

The funeral services for Mr. Warner, which were held in Hartford Sept. 4, were attended by a large number of ARRL headquarters officials and leading amateurs from nearby points, while FCC Commissioner E. M. Webster and Colonel Wesley T. Guest, chief of the Signal Corps' Army Communications Service, came from Washington for the rites together with two top FCC engineers from the New York Commission offices.

The new ARRL acting secretary and manager served four years during the war with the Coast Guard from 1942 to 1946. Mr. Budlong held the rank of Lt. Commander and participated actively in the frequency allocation planning of the U. S. armed services. Commander Budlong's major assignments were serving as alternate for the Coast Guard's chief communications officer (Commodore Webster) on the interdepartmental radio advisory committee, and in this capacity he held the post of chairman of the IRAC's technical subcommittee. He also served for two years on committees of the combined communication board and the joint communications board which dealt with frequency matters as the Coast Guard's representative.

Mr. Budlong made an important contribution in his work as a member of a special committee of the armed services which formulated world-wide communications and high frequency direction finder systems for air-sea rescue operations. He was credited as having been largely responsible for the wartime develop-

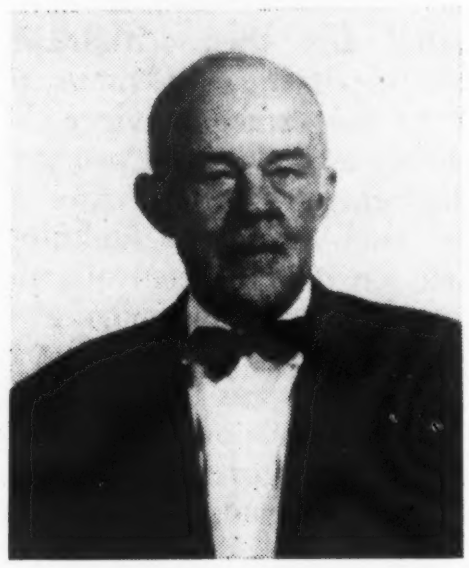
THE NATIONAL DEFENSE COMMUNICATION TEAM

A-98989

U. S. AIR FORCE

MAJ. GEN. F. L. ANKENBRANDT
Director, Air Communications

NATIONAL SECURITY RESOURCES BOARD



LEIGHTON H. PEEBLES
Director, Communications Div.

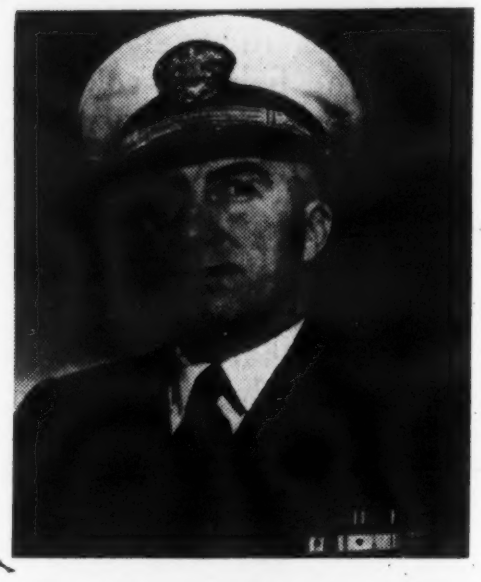
U. S. ARMY

MAJ. GEN. S. B. AKIN
Chief Signal Officer

INDUSTRY

BRIG. GEN. DAVID SARNOFF
President, AFCA

U. S. NAVY



REAR ADM. EARL E. STONE
Chief, Naval Communications

ment of the modified Gibson Girl radio transmitter adapted for lifeboat rescue communications. He also actively participated in the international telecommunications conferences held last summer at Atlantic City, N. J., as one of the representatives of the ARRL and he was regarded as having been largely instrumental in safeguarding the international amateur radio frequency space and rights during the five months conference.

Atomic Warfare Understanding

Public understanding of sound radiological defense measures must be started in peacetime, Russell J. Hopley, Director of the Office of Civil Defense Planning, who is on leave from the presidency of the Northwestern Bell Telephone Co., declared in a statement released in conjunction with an exhibit of civil defense objectives at New York's Golden Jubilee Exposition. Mr. Hopley said his office is seeking to plan a program "which includes wholesome public respect for, rather than uncontrolled fear, of atomic warfare."

New Electronic Discovery

A radically new method of controlling the flow and amplification of electric current—one that may have far-reaching influence on the future of electronics—has been discovered at Bell Telephone Laboratories. The method is based on the discovery that when beams of electrons are shot at an insulator—in this case a diamond chip—electric currents are produced in the insulator which may be several hundred times as large as the current in the original electron beam. The technique holds promise, after engineering development, of opening up an entirely new approach to the design and use of certain types of electron tubes.

G.E.'s New HF Tube

A new high power magnetron tube, with a continuous wave output of 50,000 watts at the extremely high frequency of 1,000,000,000 cycles per second has been developed under a Signal Corps contract by the General Electric Research Laboratory.

The magnetron's 50,000-watt output represents the greatest CW power ever produced at the billion-cycle frequency, according to scientists concerned with the project. Frequency of the tube's output is estimated as roughly 1,000 times as high as that of a standard broadcasting station.

The tube itself is water-cooled but,

unlike most conventional vacuum tubes which require an external source of electrical power for cathode heating, it obtains the necessary heat for the operation of its cathode by secondary emission within the tube itself created by the high velocity of the emitted electrons.

Radar Charts Bullet Course

New advances in radar make it possible to chart the speed of a bullet while it is still in the barrel of a gun. These advances also make it possible for soldiers in the field to detect the location of artillery firing on them and to pick out a moving tank from the clutter of other motionless objects on the radar screen. The new equipment can discover moving troops and is light enough to be carried in the field by soldiers.

Services to Ask Pay Boosts

Defense Secretary James Forrestal has indicated that the next session of Congress will be asked to increase the pay scales of the armed forces. This will apply to Reserves and National Guard as well as Regulars.

A civilian advisory commission which surveyed living conditions at various military installations will file its report in the near future.

Its findings, it said, are expected "to form the basis of recommendations to Congress, at the next session, for pay scales in all branches of the armed forces."

General Pay Situation

Since 1908 living costs have increased more than 250%. During the same period the base pay of officers of the uniformed services, active and retired, has been increased by only an average of about 30%, graduated from about 10% in the higher ranks to about 50% in the lower ranks. Meanwhile, civilian governmental personnel, save officers of the President's cabinet (raised 25% since 1908), have enjoyed pay increases from about 100% to more than 300%.

The present situation with respect to the pay of military services is one closely linked with and vital to a strong national defense. This is true because adequate pay constitutes a major factor for good morale. Inadequency of present service pay is causing many well qualified young men to resign their commissions and is, no doubt, deterring others, basically qualified, from entering upon military careers.

SC May Do Procuring

With the world situation and the war clouds stepping up the tempo of National preparedness, the proposal of the Munitions Board, first promulgated and then withdrawn for further clarifying study, to recommend to the armed services that all telephone and telegraph procurement be performed by the Army Signal Corps, was deemed a definite step toward the goal of centralization of procurement and purchasing under the unification program. The Munitions Board, it was learned, had not made any decision regarding the centralized procurement agency for electronic and radio military equipment and will not finally determine the telephone-telegraph purchasing for a few weeks.

Meanwhile, at the National Security Resources Board, Fred E. Henderson, on leave from Western Electric, who has launched the plant dispersion plan, was named by Chairman Hill as deputy director of production. Mr. Henderson, who is superintendent of telephone manufacture at the Point Breeze Works, has made a notable reputation in initiating a broad voluntary program of industry to consider national defense and security in locating new plants or expansion of their producing facilities. He stated early in the summer the communications-electronics industry had been in the vanguard in this move.

Lenses for Radio

An entirely new type of metal lens for focusing radio waves in radio relay systems is under development at Bell Telephone Laboratories. Present plans call for the use of the lens—theoretically capable of handling from fifty to one hundred television channels or tens of thousands of simultaneous telephone messages—in the proposed radio relay link which the Bell System is planning between New York, N. Y., and Chicago, Ill.

The new lenses are based on the theories of light transmission through atomic and molecular structures and use metallic spheres, disks, or strips in a scaled-up pattern similar to the arrangement of atoms in a crystalline molecule.—*"Ordnance"*

NAVY

Stone and Staff to Pentagon

Rear Admiral Earl E. Stone, Chief of Naval Communications, and several members of his top staff of Naval Communications now have offices in the Pentagon Building in line with the shift of the high Navy command to that building to coordinate the armed service's top staff nearby the offices of Secretary of Defense Forrestal.

The main Naval Communications center is being continued in the Navy Department, with a branch center established in the Pentagon. The latter will be linked with the main Naval Communications center.

Accompanying Adm. Stone to the Pentagon were the Deputy Chief of Naval Communications, Capt. Charles F. Horne; Capt. D. M. Agnew, Assistant Chief of Naval Communications in charge of Plans; Capt. R. J. Foley, Navy Coordinator with the Joint Communications—Electronics Committee; Comdr. J. R. Moore, Assistant Chief of Naval Communications in charge of the Frequency Section; and Lt. Comdr. A. L. Jenkins, legal officer for Naval Communications.

Adm. Holden to New York Base

Rear Adm. Carl F. Holden, former Director of Naval Communications, has assumed command of the U. S. Naval Base in New York.

During Worlld War II, Adm. Holden took part in a number of combat engagements, besides his duty as chief of Naval Communications at a most important period of expanding that branch of the Navy.

Guided Missile Test Center

One of the major projects in the expansion of the Navy's guided missile testing center, on the islands of the Santa Barbara, Cal., Channel, will be construction on barren San Nicolas and Santa Cruz Islands and on

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Laguan Peak on the mainland, of stations for "telemetering" (electronic observations by means of robot radio signals) various aspects of the performance of missiles as they hurtle out to sea. The first part of the expansion program, which will utimately cost $30 million, was to be started before October, and in the initial projects around $14 million will be expended with the latter program to take about 3 years.

Dr. Taylor and Radar

In retiring after thirty-one years with the Navy as civilian employe or commissioned officer, Dr. A. Hoyt Taylor leaves behind him an extraordinary record of scientific achievement. Reference was made at a retirement ceremony to Dr. Taylor's pioneer work on radar, for which he received the Medal of Merit after World War II. Dr. Taylor persuaded the Navy Department that his crude electronic "eye," first tested on the Potomac in 1921, should be installed aboard every warship.

The British, who gave major credit to radar for the defeat of the Luftwaffe during the Battle of Britain, have said they first learned about the device from reports of Dr. Taylor's experiments printed in scientific journals in 1922. Those reports told of the discovery by Dr. Taylor and an assistant, Leo Young, that shortwave radio impulses sent from the Bellevue Naval Research Laboratory to the Virginia shore were distorted every time a boat passed between the transmitting station and the receiver across the river. They knew that radio waves were interfered with by mountains or other large objects, but this was the first time that a small wooden boat had been known to interfere. If these waves could–detect a wooden boat moving on the Potomac, Dr. Taylor reasoned, why not use them to detect enemy warships approaching at night or in a fog? He made the revolutionary suggestion in a memorandum to the department in 1922. Nothing happened. Dr. Taylor and his assistants continued their electronic studies and in 1930 noted that Bolling Field airplanes in flight also could be detected with an improved instrument. Finally, in 1931, the department issued its first orders for intensive research in this field: "Investigate use of radio to detect the presence of enemy vessels and aircraft. Special emphasis on the confidential nature of this problem." Meanwhile, British and German military authorities had begun secret studies, too, with the British making the better progress. The rest of the story of radar is history.

It is evident that not only the United States but Britain and our other allies owe a debt of gratitude to Dr. Taylor. For it is not stretching the truth to say that his early observations and experiments at his laboratory on the Potomac paved the way for the major contribution to Allied victory which radar made in the recent war.

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Stone in Talk at War College

Rear Admiral Earl E. Stone, Chief of Naval Communications, addressed the officers attending the current course of the Naval War College at Newport, R. I., on Thursday, Aug. 19. Another description of the present operations and scope of Naval Communications was given before the Naval War College students by Captain Charles F. Horne, Deputy Chief of Naval Communications, Aug. 23.

Navy and SC Mica Synthesis

A synthetic mica has been produced for the first time with the desirable characteristics of natural mica, strategic stockpile material used in electronic equipment.

The synthetic material is being produced on a pilot-plant scale under a coordinated research program sponsored by the Office of Naval Research, the Army Signal Corps and the Navy Bureau of Ships.

Production of synthetic mica on a commercial scale will make the United States independent of foreign sources for the strategic mineral that is widely used in Army and Navy communication and electrical equipment. Although natural mica is found in several parts of this country and despite a government subsidy of $6.00 a pound, only 15 per cent of the amount needed in the critical war years of 1943 and 1944 was produced here.

The Government has considered the mica supply sufficiently acute to designate needed grades of the mineral as Class A strategic materials under the recently enacted Stockpiling Act.

Government-sponsored research on mica synthesis was initiated under a Signal Corps contract at the Colorado School of Mines on June 15, 1946. The Interior Department's Bureau of Mines Electrotechnical Laboratory, at Norris, Tennessee, began synthetic mica pilot-plant work on September 1, 1947 under an Office of Naval Research contract. The contract was negotiated at the request of the Bureau of Ships, which stimulated the development of synthetic mica for the Navy. Funds are supplied by the Navy and the Army Signal Corps. The program is being coordinated by a committee consisting of two Navy and two Army Signal Corps members.

Underwater Television

Scientists and Naval Officers grouped around a television screen aboard the U.S.S. Coucal, submarine rescue vessel, recently watched fish swimming near the bottom of the Bikini Lagoon, 160 feet below, in a demonstration that is believed to be the first successful operation of underwater television equipment.

The demonstration opens what scientists and military men believe may be an entirely new field in deep water investigations. The equipment used for the Bikini experiment consisted of a Naval aircraft television camera and monitor specially adapted for the operation by the Cornell University Aeronautical Laboratory of Buffalo, New York.

The basic equipment is similar to that used by the Navy for monitoring instruments in drone airplanes. The underwater camera was lowered from the submarine rescue vessel to the deck of the target submarine *Apogon* lying in about 160 feet of water, where she was sunk by the underwater atomic bomb explosion last year.

The camera was focused and operated by a control engineer aboard the U.S.S. *Coucal.* When brought into focus, a sharp five-inch, square image appeared on the television screen. Fish of various sizes could be seen swimming around the submarine's deck and past the underwater television camera lens. When the fish swam toward the camera, the green-colored television screen seemed more like an aquarium window than a screen.

Deep sea divers, who made daily underwater examinations of target ships on the floor of Bikini Lagoon, said the television image approximates in clarity what they themselves see when on the bottom. For the experiment, which was conducted on August 22, 1947, natural light, filtering down through the clear blue salt water, provided sufficient illumination.

Regulation Navy diving lights can

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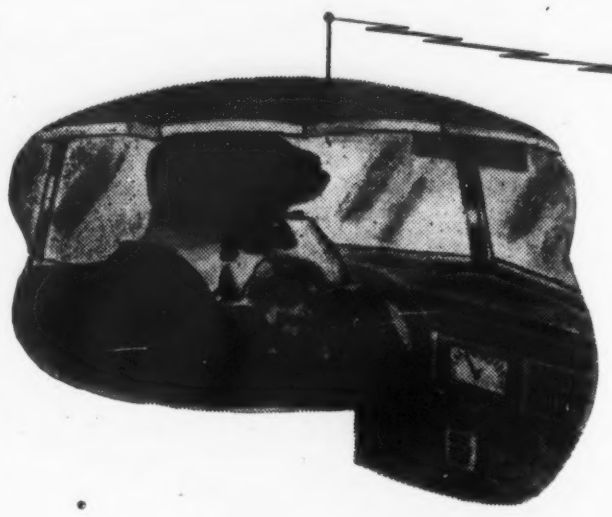

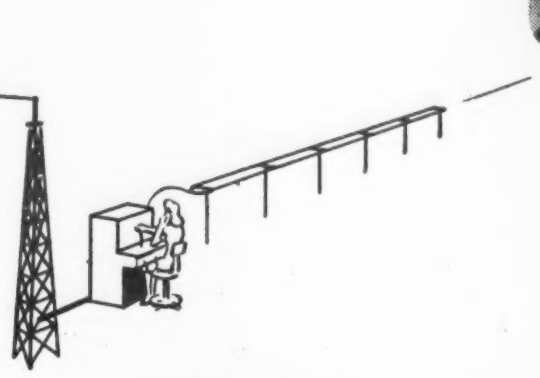

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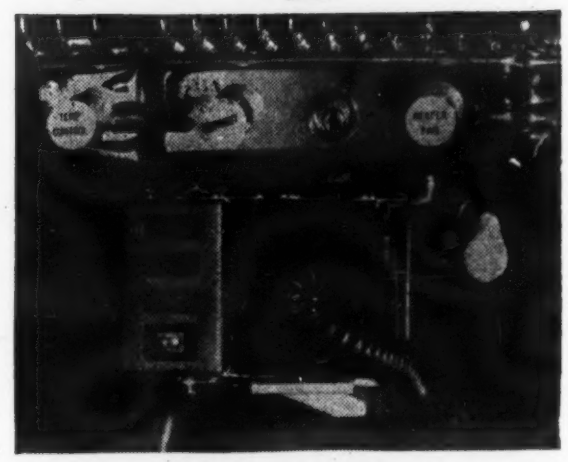
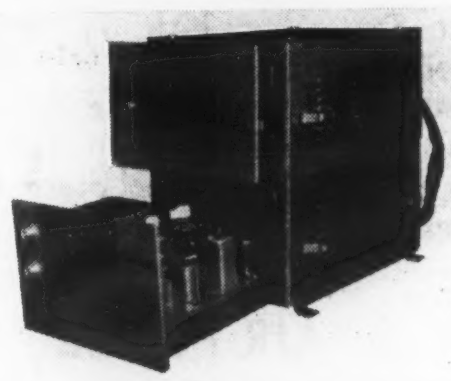


Control unit in vehicle is easily accessible and highly compact.



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be used with the underwater television camera when necessary. The experimental equipment used at Bikini proved too bulky for divers to carry at the depths in which they worked. However, the underwater camera can be lowered to the deck of a sunken ship, permitting observers topside to study those areas on which the lens is focused.

Captain Christian L. Englemen, U. S. Navy, project officer for the Bikini scientific resurvey, after witnessing the demonstration predicted that underwater television will open a new chapter in the field of subsurface scientific studies. Actually, though, underwater television will play no part in the underwater examination of target ships now being concluded by resurvey divers at Bikini.

At Bikini, the equipment was operated by Mr. Richard E. Frazier and Mr. John P. Gould, electronics engineers from the Physics Department of the Cornell University Aeronautical Laboratory. Mr. Karl D. Swartzel, head of the Department, and Mr. Lloyd R. Everingham, of the same organization, directed the underwater modification of the television equipment for the Bikini scientific resurvey.

Navy Radio Sends Official Report on Bernadotte Murder

The Naval Communications radio station in the United States consulate in Jerusalem flashed the official report September 17th on the tragic murder at Tel-Aviv by the Sternist terrorists of Count Folke Bernadotte, UN peace mediator for the Arab-Jewish dispute, to the State Department in Washington.

AIR FORCE

Col. Smith CO of AACS

Col. Wallace G. Smith, who has been commanding officer of the 7th AACS Wing at Tokyo, has returned to the United States to become commanding officer of the Airways and Air Communication Service of the U. S. Air Force. His arrival allows Maj. Gen. H. M. McClelland, former AACS commander, to give full time to his duties as Deputy Commander for services of the recently formed Military Air Transport Service. Taking over that post in June Gen. McClelland had continued as head of AACS until the arrival of his successor. The AACS is now but one of several services within the command of Gen. McClelland.

Col. D. B. White, who has been communications officer of the Far Eastern Air Force Command, returned with Col. Smith to become deputy commander of the AACS.

Protection of New Orleans

Adequate protection of the New Orleans area against possible future sneak air attacks is the motivating purpose behind pending activation of the Aircraft Control and Warning Squadron of the Louisiana National Guard, according to Maj. Gen. Raymond H. Fleming the state adjutant general.

The organization, to have an eventual strength of 29 officers and 362 enlisted men, will have its headquarters at Michaud with branch Close Support Radar Stations at both Baton Rouge and Houma. The unit expects to receive radio, radar and related equipment valued at nearly $1,000,000 from the Federal Government.

The squadron will utilize the latest warning devices to detect the approach of enemy aircraft in the event of hostilities. The direction of approach, distance, speed, height, numbers and other data would all be calculated quickly by members of the squadron and immediately be passed along to Air Force fighter interception squadrons and other forces which would be mustered against such an attack, Gen. Fleming explained.

"Zero Reader"

A new technique for flying, navigating, and landing under bad weather conditions, made possible with a precise electronic instrument, has been announced by the Sperry Gyroscope Company.

The new instrument, called the "Zero Reader," eases pilot strain and reduces the need for periodic practice on instrument landing systems. It automatically pieces together the information from conventional flight instruments and presents their indications to the pilot on a simple two-element indicator.

Developed primarily to make manual landing on ILS easier for the average pilot, the Zero Reader is also applicable to instrument climbouts, procedure turns, and constant altitude flying on Gyrosyn Compass headings and available radio tracks. The Zero Reader enables pilots with little or no ILS experience to make acceptable approaches on beam systems.

Airline pilots who have tried the new instrument on test flights state that so much of the strain of instrument approaches is relieved that the Zero Reader will practically eliminate missed approaches in bad weather.

An extensive flight evaluation program was recently completed by the Air Transport Association. During this program pilots of member airlines and the CAA flew both standard and "Zero Reader" approaches on ILS at more than 12 airports. With few exceptions each airline pilot flew a more accurate aproach on the new aid to instrument flight than on the straight manual ILS run.

The evaluation program proved the Zero Reader to be an important development in cockpit instrumentation. Conclusions show that if properly employed it should reduce pilot training requirements on instrument approaches and provide more precise approaches for a given degree of pilot skill. This would conceivably permit safe manual flights to lower weather minimums than now possible on conventional ILS facilities.

The Zero Reader is designed (a) for use in airplanes not equipped with automatic pilots and (b) as standby equipment for automatic approach control. It is not expected to replace any existing flight instruments.

AF's Bright Lights vs Fog

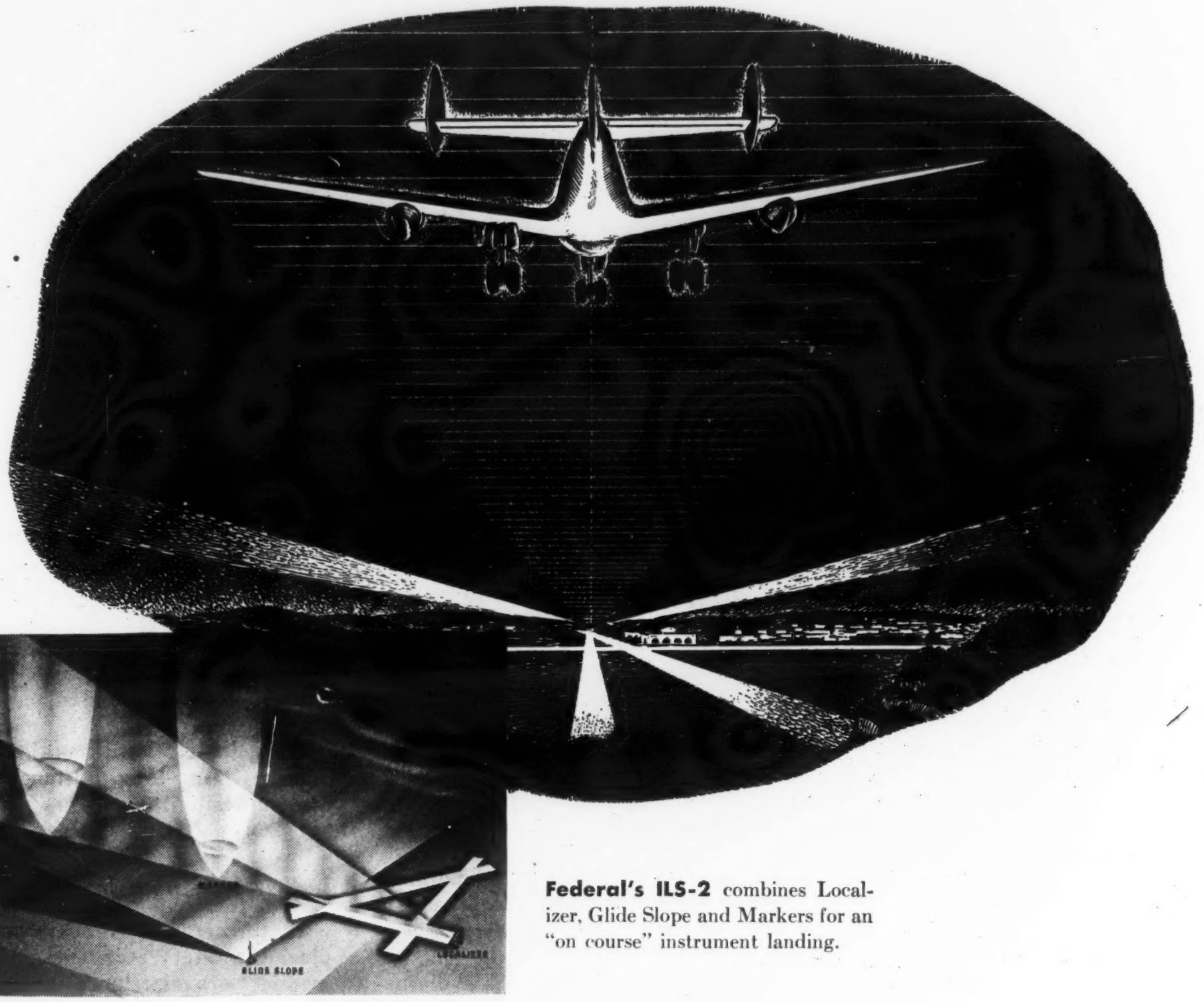
The world's brightest lights will be pitted against the nation's thickest fog this autumn by the U. S. Air Force in its constant search for a way to take the "blindness" out of "blind" landings.

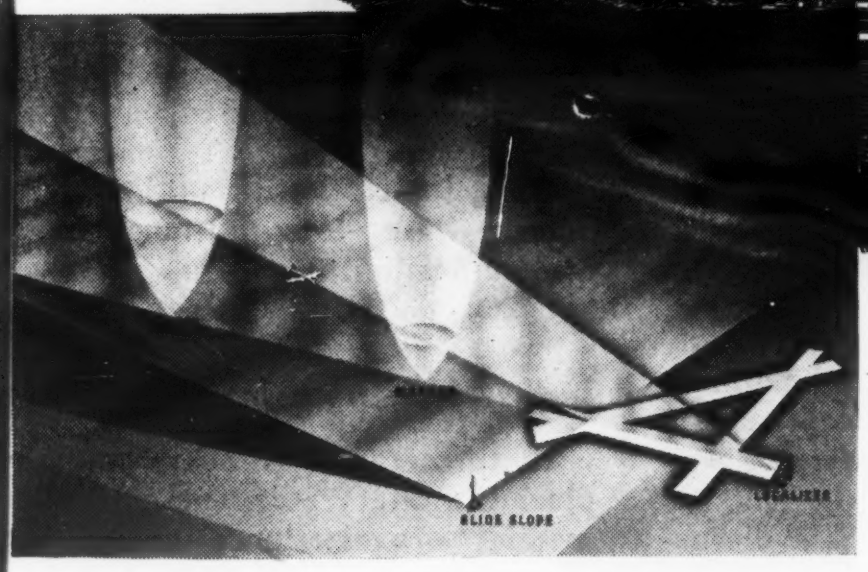
The new lights will be tested at the armed forces landing Aids Experiment Station, Arcata, California which is considered the foggiest spot in America. The Air Force has ordered for Arcata a system of newly-developed all-weather approach lights which are designed to penetrate "zero-weather" fog for at least 1,000 feet. The system will include 36 of the world's brightest lights—3,300,000,000 peak candlepower each—and 35 lights of somewhat lesser

HOMEWARD PATH . . .

ILS-2 Contributes to Air Safety . . . Improves Operations

Today the landing of aircraft by means of the radio beam Instrument Landing System—known as the ILS—is a routine operation in important airports throughout the world. Accepted as standard equipment by national and international aviation bodies, the use of this system during the past winter has permitted many air operations which would not have been possible without it . . . operations which were carried out with safety . . . providing better service for the public, better income for the airlines. "Missed approaches"—the overshooting of the landing strip—are virtually eliminated with ILS. The I T & T version of this system—known as Federal's ILS-2—has been ordered and is being installed in many countries throughout the world. I T & T and its manufacturing associates have led in the development and manufacture of radio aids to navigation for more than 28 years.





Federal's ILS-2 combines Localizer, Glide Slope and Markers for an "on course" instrument landing.

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I T & T is the largest American system of international communications. It includes telephone networks in many countries, 47,000 miles of submarine cable, 6,600 miles of land-line connections, over 60 international radio-telegraph circuits and more than 50 international radiotelephone circuits.

I T & T DEVELOPMENT AND MANUFACTURING

Associates of I T & T maintain electronic laboratories in the United States, England and France, and operate 31 manufacturing plants in 22 countries which are contributing immeasurably to the rehabilitation and expansion of communication facilities in a war-torn world.

WORLD UNDERSTANDING THROUGH WORLD COMMUNICATIONS

brilliance. Lined up in a row two-thirds of a mile long, the 71 lights will produce lightning-like flashes to guide fog-bound pilots to the Arcata airfield runway.

When used in conjunction with the instrument landing system, popularly known as ILS, the new approach lights will make possible nearly normal visual landings despite the poorest visibility conditions. At Arcata thirty-six krypton "flash" units will be placed in line alternately with 35 neon "blaze" units for almost two-thirds of a mile. When flashed one after another, the lights in line will appear as a lightning stroke traveling toward the landing strip from the "inner radio marker" to which the pilot is guided by the ILS radio system.

The key to the tremendous brilliance of the krypton flash unit is a lamp the size of a cigaret developed during the war. The lamp, only four inches long, is a slender quartz tube filled with krypton, one of nature's rarest gases. When a surge of electricity is discharged through the gas, the lamp flashes with a brilliance of ten million candlepower per square inch—ten times greater than that of the sun. The reflector and optical system of the lightning unit magnifies this flash to three and one-third billion beam candlepower—the equivalent during its brief interval of 50 million 60-watt household bulbs and brighter than the largest searchlight ever built.

The line of 71 lights will flash 40 times a minute and can be varied in intensity in accordance with weather conditions. In clearer weather, the krypton units can be cut in brilliance, or they can be turned off altogether in favor of the less brilliant neon units which serve either as flashing or steady-burning lights of five different intensities.

A six-light installation at the Cleveland Municipal Airport has been tested for over a year with great success. The first full commercial installation of an approach system recently was completed at New York City's new International Airport.

All-Weather Flying and Radar

Without radar the Air Force's all-weather airline, between Wilmington, Ohio, and Andrews Field at Washington, D. C., could not have achieved its two-year record of flying in perfect schedule through all types of weather, the Air Force disclosed in its announcement that these operations have been terminated on a scheduled basis.

All landings in the daily round trips, flown five days a week, were accomplished by radar ground-controlled approach units (GCA) which plotted the aircraft over a field and talked the pilot into position along the glide path. Other radar devices used included radar navigational beacons installed every 100 miles along the Wilmington-Washington airway, and the traffic control unit, CPN-18, which controls aircraft for over 40 miles from its site on the airbase, permitting a gradual letdown, as well as assisting precision radar at the landing. (*The CPN-18 was fully described in the article "Radar Approach Control," by Capt. Henry F. X. Hession and Thompson J. Simpson, which appeared in the July-August issue of* SIGNALS.)

Line Inspection by Air

The Air Force is flight-testing the two-place helicopter XH-15. Its bubble-like nose providing exceptional visibility, the XH-15 is designed for use as an observation plane, for special photographic work, and for aerial inspection of power or communications lines.

SIGNAL CORPS

Analysis Program Conference

An address by Major General Spencer B. Akin, Chief Signal Officer, recently opened a three-day conference on the Signal Corps Cost and Productivity Analysis Program in the Pentagon. The conference was attended by several representatives of the Department of the Army and approximately fifty officers and civilians representing all Signal Corps activities. Objective of the conference was a review of the status and results of the analysis program and a discussion of current policies, methods and procedures.

Supply Functions Shift

Signal Corps supply functions now being carried out by the Columbus, Ohio, and Schenectady, New York, General Distribution Depot, were recently transfered to the Baltimore, Maryland; Lexington, Kentucky and Decatur, Illinois, Signal Depots.

The move will be taken in the interests of more economical and efficient utilization of Army installations. Space hitherto utilized by Signal Sections of the Schenectady and Columbus Depots will be allocated to the expanding activities of other technical services located at those depots.

Under the move, Signal Corps supply distribution responsibilities for stations and other installations in the First Army Area, together with the New York Port of Embarkation, the Military District of Washington, and the States of Pennsylvania and Maryland, will be assumed by the Baltimore Signal Depot.

Similar responsibilities within the Second Army Area, excluding Pennsylvania, Maryland and the Military District of Washington, will be taken over by the Lexington Signal Depot.

Signal supply distribution to posts, camps and stations in the Fifth Army Area will be assumed by the Decatur Signal Depot.

Signal Sections at the Columbus and Schenectady General Distribution Depots will be completely inactivated about September 30th upon liquidation of Signal stocks stored at those installations.

New Ionosphere Recorder

First of three models of a newly developed ionosphere recorder for field use has been accepted by the Army Signal Corps from the Maryland Electronic Manufacturing Corporation, College Park, Maryland, the Office of the Chief Signal Officer said recently.

Like fixed equipment, the transportable sets will make a photographic record to be used in predicting the condition of the ionosphere as a basis for selecting optimum frequencies for long distance radio communication.

Industry Courses for SC

In furtherance of its program of placing military personnel with commercial organizations for training purposes the Signal Corps has announced that for the current year four officers and twelve enlisted men will be assigned to the American Telephone and Telegraph Company; two officers and five enlisted men to the Western Union Telegraph Company and five enlisted men to the General Aniline and Film Corporation. The courses at A T & T include message traffic and plant procedures; those at Western Union cover all phases of wire communication while the courses at Ansco are concerned mainly with color photography.

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Ingles Gets C.B.E.

Major General H. C. Ingles, former Chief Signal Officer and now President of RCA Communications, Inc., has been made an Honorary Commander of the British Empire, Military Division. The award was presented by Sir Francis Evans, British Consul General, at a recent ceremony in New York.,

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ACS Sole Expedition Contact

The Signal Corps' Alaska Communication System is providing the sole means of contact with the world for the Arctic Institute Expedition headed by Sir Hubert Wilkins and now operating on Seward Glacier. Messages are being relayed to and from the explorers on the slopes of the mountain range that towers more than 14,000 feet.

SCEL Unit at Key West

An experimental installation under the Signal Corps Engineering Laboratories will be established near Key West, Florida, it was announced recently by the Office of the Chief Signal Officer. The installation will be in an area of 85 acres of land and water recently withdrawn from the category of surplus. The area is the East Martello Battery site, also known as the Salt Pond area, Harbor Defense of Key West, Florida.

SC Surplus to Schools

More than $31,000,000 in surplus equipment has been made available to American educational institutions since January 1, 1947, through the Signal Corps donation program, according to Brigadier General Calvert H. Arnold, Chief, Procurement and Distribution Division, Office of the Chief Signal Officer.

Through the U. S. Office of Education, the Signal Corps received requests for various types of equipment from 2,807 institutions and was able to supply 13,655 items. Requests came from all 48 states and and the District of Columbia. Radio and radar sets comprised the bulk of the items.

Among many commendations for the successful operation of the program was a letter to Major General Spencer B. Akin, Chief Signal Officer, from Arthur L. Harris, Chief of the Surplus Property Utilization Program, U. S. Office of Education.

"On behalf of the thousands of schools, colleges, and universities which have shared in the distribution of Signal Corps donable property," Mr. Harris says, in part, "I take pleasure in adding to this expression of appreciation.

"Science instruction is being made more meaningful, technical training is being more nearly modernized, and educational curricula are closing a part of the gap between educational offerings and technical and scientific advancement. No small portion of the credit for these accomplishments is due to the Signal Corps and to the members of your staff who have implemented the policies of your office in the program."

The Transistor

Possible revolutionary changes in Army communications equipment are foreseen by Major General S. B. Akin, Chief Signal Officer, following announcement by Bell Laboratories of a tiny electronics device called a transistor.

General Akin ordered immediate tests of the transistor which, Bell Laboratories say, will do most of the things that a vacuum tube will do and some that vacuum tubes do not do.

The transistor is important to the Army because, having no filament, it requires no heating current to do its job of amplifying voltages. In portable communications equipment, such as the walkie-talkie and the handie-talkie, a large part of the weight and bulk consists of batteries used to heat tube filaments. The transistor could take a great load off the ground soldier's back.

Colonel Edwin R. Petzing, head of the Engineering and Technical Division of the Office of the Chief Signal Officer, declared that the transistor holds "promise of having great military value, and the Signal Corps has already made plans to investigate thoroughly its possibilities." The device was demonstrated to representatives of the Armed Services before public announcement of its development.

Colonel Petzing added: "One of the most difficult problems in the development of a small portable radio set is that of the dry cell power supply. Present standard handie-talkie and walkie-talkie radio sets have respectively, 29 per cent and 39 per cent of their weight and 46 per cent and 75 per cent of their volume taken up by the dry batteries. Use of transistors would entirely eliminate the need for the 'A' section of these batteries to heat the cathodes and substitute a low current drain biasing battery with a resultant overall saving of 25 per cent or more in both battery weight and volume. This is only one example of many applications which will be investigated."

Laying Wire by Helicopter

The feasibility of laying telephone wire for military purposes by helicopter has been demonstrated by Signal Corps engineers through recent tests at the Signal Corps Engineering Laboratories, Fort Monmouth, New Jersey. The tests also demonstrated that helicopters could be used advantageously for the inspection of field telephone lines.

To determine the accuracy with which wire may be payed out, a course was plotted and a marker placed in an open meadow. Wire was then successfully laid within a yard of the marker and between trees separated by a few feet.

In another test wire was laid across tree tops at the foot of a gully which had proved impassable for wire laying crews and had been bypassed. As a result of the short cut the wire line was shortened by half a mile.

A flight to determine the value of maintenance purposes of line inspection followed several miles of Laboratory test line at an average height of 40 feet, the pilot often descending to wire level to permit close scrutiny for breaks.

The engineers concluded that the use of a helicopter for accurate wire laying and for inspection purposes offers advantages over the airplane which was occasionally employed in wire laying during World War II.

"Kaiser" Decorated

Major General S. B. Akin, the Army's Chief Signal Officer recently received a citation and a gold leg band for Kaiser, aged pigeon-veteran of two world wars.

The awards came from the First Retread Post No. 667, American Legion, of Los Angeles, California, with a request that they be forwarded to the famous bird at the home of the Signal Corps made for him at Fort Monmouth, New Jersey.

Kaiser, 31 years old and retired, was deemed eligible for the "Retreads" because he served in both major conflicts. During World War II, he helped train other carrier pigeons, some of them his direct des-

Machines in RCA's Lancaster Tube Plant are designed for mass production of Kinescopes—television picture tubes—at lowest possible cost.

Behind the magic of a Television Tube

Every morning, 14 tons of glass "bulbs" go down to the production lines at the RCA Tube Plant in Lancaster, Pa.

By evening, the bulbs are television picture tubes, their luminescent faces ready to glow—in television homes everywhere—with news, sports, entertainment, education, politics.

Born of glass, metals, chemicals, the picture tube comes to life through flame and heat. Its face is coated with fluorescent material—forming a screen on which an electron gun "paints" moving images.

Each step is so delicately handled that, although RCA craftsmen are working with fragile glass, breakage is less than 1%.

Water, twice-distilled, floats the fluorescent material into place on the face of the tube, where it clings by molecular attraction—as a uniform and perfect coating.

Every phase of manufacture conforms to scientific specifications established by RCA Laboratories. Result: Television tubes of highest perfection—assuring sharp, clear pictures on the screens of RCA Victor home television receivers.

• • •

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RADIO CORPORATION of AMERICA

cendants through as many as six generations.

The Legion's gold leg band will match an aluminum one Kaiser still wears bearing the seal of the German Imperial Crown. The pigeon patriarch was hatched at Cologne, Germany, in February 1917, and was trained for Kaiser Wilhelm's army. He was captured by American troops in the Meuse Offensive of World War I and turned over to the Signal Corps, a prisoner of war. He now holds the undisputed record as the oldest carrier pigeon in the world. He has outlived more than a dozen mates.

Changes in Key Personnel

At the suggestion of some of AFCA's members the regular feature "Changes in Key Personnel" has been dropped. The principal reason for this is the fact that Navy and Air Force communications personnel are not listed separately and it is, therefore, impractical to list changes of key officers assigned to communications work in those services. If you have any comment on this change in our policy write to the editor of SIGNALS.

CIVILIAN COMPONENTS

Eisenhower Trophy

General of the Army Dwight D. Eisenhower, former Chief of Staff, who, as Supreme Commander, led the Allied Forces to victory in Europe, will give his name to a trophy to be awarded the outstanding Army unit of company size of the National Guard in each State, Major General Kenneth F. Cramer, Chief of the National Guard Bureau, announced recently.

The Eisenhower Trophy will be in the form of a cup fifteen inches high. It will be a perpetual award given annually, and the winning unit each year will be given a smaller replica for permanent possession.

"Only Army units of the National Guard which have attained 100 per cent of the enlisted strength authorized by the Chief, National Guard Bureau for the year of competition and, thereafter have maintained an average of 90 per cent of actual strength, will be considered for the award in each state," General Cramer said.

Other factors entering into the selection of the winning unit in each State will be performance in summer field training, performance in armory training, and the qualification of the unit with individual and crew-served weapons. The winning unit will be selected within each State by a board composed of the Adjutant General of the State, the Senior Tactical Army Commander in the State and the Senior Army Instructor, who will represent the Army or Territorial Commander.

Reserve Economic Courses

Army Reserve officers, whose possible future war assignments will be at the policy-making level, are to be selected to attend economic mobilization courses in seventeen major industrial cities during 1948-49.

Brigadier Gen. Wendell Westover, Army Executive for Reserve Affairs announced recently that 15 Reserve officers will attend each class; a total of 255 will be selected for the courses throughout the country. In general, those officers chosen will be in the grade of major or above and will have had mature experience in military and civilian capacities.

At the same time, Major Gen. Kenneth F. Cramer, Chief, National Guard Bureau, announced that selected National Guard officers will also attend these special training courses, which are to be conducted by the Industrial College of the Armed Forces.

College students who have been enrolled in the Reserve Officer Training Corps before June 24, 1948, will automatically be deferred from the military draft until after completion of their course, the Army and Air Force announced recently. They must remain in good standing in their military and academic work.

The Army has an ROTC quota of 77,800 and the Air Force one of 40,800. These quotas are distributed among 231 colleges and universities.

To be eligible for deferment, the ROTC students must agree to accept a commission in the Army or Air Force, if and when offered, and to serve not less than two years on active duty as an officer subject to call by the Secretary of the Army or Air Force in whichever branch he holds his commission.

There is an increasing need for Reserve and National Guard officers to volunteer for return to the Army for extended active duty tours in order that vacancies caused by the current expansion program can be filled by experienced personnel, the Department of the Army announced recently.

A total of approximately 37,000 additional officers will be needed between now and the end of June, 1949. The immediate requirement is for 6,000 Reserve and National Guard officers who held the grade of lieutenant or captain prior to their release from active duty at the end of the war. While vacancies exist in all arms and services, Infantry, Medical Corps, Dental Corps, Medical Service Corps, Field and Coast Artillery, and Signal Corps officers are in the greatest demand. Nurses are also urgently needed. At present there are 542 vacancies in the Army Nurse Corps, and this number will be considerably magnified when 30,000 young men are added each month to the expanding strength of the Army.

Reserve and National Guard officers, as well as former World War II Army of the United States officers who are physically fit and come within the recently liberalized age in grade limits, may volunteer for extended active duty. The length of each tour is three years, except for Medical and Dental Corps officers who may elect tours of one, two or three years duration. Applications will be considered from lieutenants and captains who are under 47 years of age.

Former Army of the United States officers who do not hold either a Reserve or National Guard commission may apply for a reserve commission at the same time they request recall to active duty. All successful applicants for extended active duty will be recalled by the Army in the grade they held prior to relief from active duty.

Faster Application Handling

The Department of the Army announced recently that the processing of applications from Reserve Officers requesting extended active duty tours will be greatly speeded up because of the introduction of several short cuts in the former procedure.

A Reserve officer applying for extended active duty will now obtain a final type physical examination at any nearby military medical facility prior to submitting his application.

Formerly, physical examinations were accomplished after the applicant had been accepted for extended active duty. With the report of physical examination attached to the application form when it is forwarded for

processing, the period between the time the papers are sent in and the officer is notified to report for duty will be considerably reduced.

All Army installations involved in conducting physical examinations will give the required final type examination to any individual who requests it for the purpose of applying for extended active duty. No written authorization is required. The completed report of the examination will be given to the individual concerned for attachment to his application form.

Another step in speeding up the processing of extended duty applications provides that orders for accepted applicants will be issued directly by the Department of the Army instead of through Army Commanders as has been the case up to this time. This new method will eliminate several additional time consuming steps in the processing of applications.

Graybar Signal Units

The Graybar Electric Corpany has agreed to sponsor two Signal Corps Reserve units under the Department of the Army's Affiliation Program, Major General Spencer B. Akin, Chief Signal Officer, announced recently. A Signal Base Depot Company will be organized in Chicago and a Headquarters and Headquarters Company of a Signal Base Depot Company in San Francisco.

Reserve Commissions Open

Civilian experts experienced in any one of 76 broadly defined professional and technical specialties will be tendered commissions in the Army if they apply and qualify under provisions outlined in recently issued instructions, the Department of the Army announced recently.

The commissions range from those of second lieutenant up to and including colonel, depending upon the qualifications and experience the individual possesses in a given specialty. Applicants must be at least twenty-one years of age for initial appointment in the Reserve Corps and applications will be considered from individuals up to 55 years. All must be citizens of the United States. No previous military experience is required.

In addition to the fields of medicine, engineering, accounting, education, transportation and psychology, the list contains a wide variety of other civilian specialties which are very essential and immediately adaptable to the needs of the Army. They run the gamut from laundry and dry cleaning specialists to experts in shipbuilding.

Application forms may be secured from local Reserve Unit Headquarters or Organized Reserve Unit Instructors or by writing to Army Headquarters at New York, Baltimore, Atlanta, Chicago or San Francisco, or to The Adjutant General, Department of the Army, Washington, D. C.

ROTC Conference

Among ROTC Senior Instructors attending a recent 16-day conference at Fort Monroe, Virginia, were Lt. Col. Herrick F. Bearce, Signal Corps, Assistant PMS&T at Massachusetts Institute of Technology and Lt. Col. Giles H. Gere, Signal Corps, Assistant PMS&T at Ohio State University. The conference, called to revise the scope and details of the senior ROTC program, was composed of officers from colleges and universities in the First, Second, Fourth and Fifth Army Areas.

ROTC Cadets 80% vets

A survey of the records of the 380 Signal Corps ROTC cadets who attended the summer training camp at Camp Wood, N. J. shows that 304 were veterans of World War II, virtually all with overseas service. Seventy served with the Signal Corps, 60 were in the Navy and thirteen were ex-Marines. The remainder served in other branches, most of them in some way associated with communications.

Signal Corps Recall

The Army Signal Corps will have to recall 471 Reserve officers, the majority in company grades, if it is to meet expanding training requirements, the Office of the Chief Signal Officer announced recently.

Authority to establish the recall quota was granted by the Secretary of the Army in the light of a serious shortage of officer personnel. The quota permits the recall of nine lieutenant colonels, 85 majors, and the balance in company grades. Reservists may be recalled to extended active duty only with their consent.

The normal tour for officers returning to extended active duty is three years. Early application by interested reservists was urged by the Office of the Chief Signal Officer, with emphasis placed on the growing need for officers to train inductees and lead units in the expanded Army.

Information and forms for making application may be obtained from Organized Reserve Corps or National Guard unit instructors.

NBC Signal Unit

The National Broadcasting Company has accepted sponsorship of a Signal Reserve unit under the Department of the Army Affiliation Program, Major General Spencer B. Akin, Chief Signal Officer, announced recently.

In a letter received from Mr. Niles Trammell, President of NBC, the company has agreed to sponsor a Mobile Radio Broadcasting Company to be organized in New York City as a part of RCA's participation in this phase of the National Defense effort.

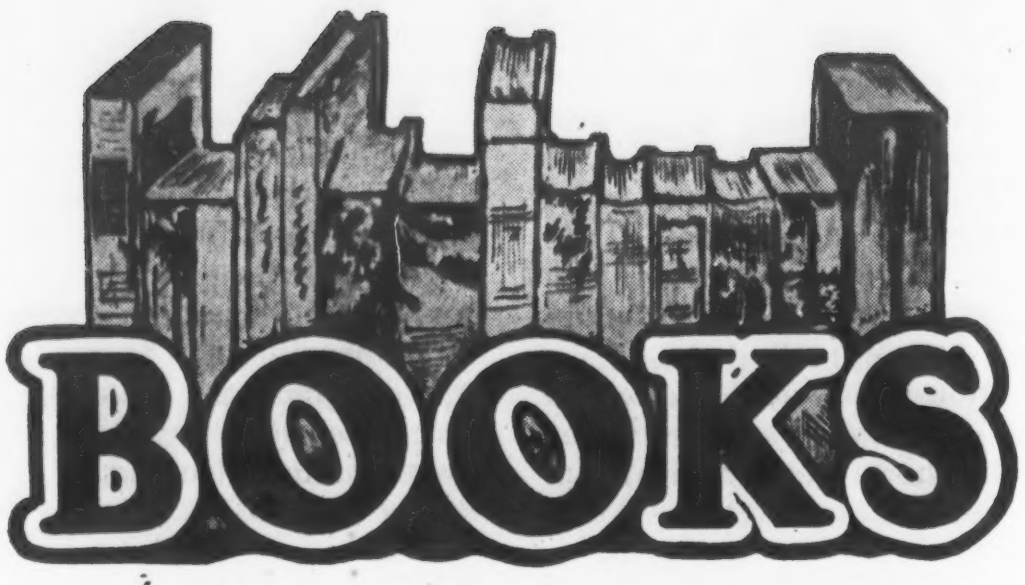
NG Officers Assist Training

Twenty-nine National Guard officers representing sixteen states and the District of Columbia have been assigned to the National Guard Division, Training Section, Office of the Chief, Army Field Forces, to assist in developing a three-year training program for the National Guard, General Jacob L. Devers, Chief, Army Field Forces said recently.

The officers assigned by their respective states to attend this special Army Field Forces training course, will be at Fort Monroe, Virginia, for at least thirty days, during which time they also will receive instruction in the planning of training programs of their individual units.

The proposed three-year program will be a revision of the old six-year program. Plans for the new program include the omission of certain subjects which are often too advanced for the average unit, and which could be more easily taught after a National Guard unit is mobilized.

Officers on temporary duty are joining with regular officers in revising the program, which will affect 250,000 men this year. They will be afforded an opportunity to express themselves and exchange ideas for the new training program in addition to receiving instruction on advanced policies and procedures of Army training.



AND SERVICES

GETTYSBURG. Edited by Earl Schenck and Richard A. Brown. 308 pages. Rutgers University Press. $3.50.

NO STUDENT of the Civil War, or casual reader about that period and the Battle of Gettysburg can afford to miss this book. There is a fiction style to it. The treatment is pleasing—much different from usual war history. There is an intimacy with the great battle that is not found in pure military documentation. There is human emotion in it, with the reader plunged deeply into the feel of Gettysburg and "living" the events to the finish. The unusual maps by Harold Detje are entirely adequate to the purpose of the story.

The wide variety of sources drawn upon in the assembling of the story includes young and old, male and female, civilian and soldier, Blue and Gray. The result is unique war history. There was Sallie Broadhead, a school teacher who lived in Gettysburg. She kept a diary, extracts from which give the picture as the townspeople saw the battle develop. Then, there was Billy Bayly, thirteen years old, who lived on a farm west of Gettysburg and who follows the battle from the first contact and is much of the time behind the Confederate lines. But most of all there is Frank Haskell, born in Vermont, educated at Dartmouth, who left his law practice to serve as aide to a Union division commander. His letter to his brother, which is quoted again and again, must rank among classic American historical documents. Less than a year after Gettysburg, he was killed at Cold Harbor. He describes generals and the men in ranks with frankness and understanding. General Reynolds, killed at Gettysburg the first day, he describes as he saw him at Fredericksburg—"a very beau ideal of the gallant general mounted upon a superb black horse, he was everywhere on the field, seeing all things and giving commands. . . ." And Hancock he saw as "the most magnificent looking general in the Army of the Potomac at that time." There were others, however, who did not at all inspire his admiration. One Union brigade, on July 3rd, lost 62% of those actually engaged that day. Just as Haskell describes the battle as he saw it from the Union side, John Dooley, foot soldier who loved "Uncle Robert" E. Lee, tells it as seen by the Confederates. You live the whole battle as you read "Gettysburg," as you have never done before.

THE GATHERING STORM, by Winston Churchill. 784 pages. Houghton Mifflin. $6.00.

FROM THE world's senior statesman comes the first installment of the history for which we have been waiting. Perhaps you sampled this work in Life's 50,000 word teaser, or via the more substantial 93,000 words dished up by The New York Times. Or perhaps you dislike samplings and preferred ot wait for the release in late June by Churchill's publishers of the complete, nearly quarter-million word text.

"The Gathering Storm" is the first of five (possibly six) volumes in a work titled "The Second World War." Mr. Churchill states in his preface that he regards these volumes as the continuation of the story of the First World War covered in his previous books, "The World Crisis." "The Eastern Front," and "The Aftermath." The whole is designed to "cover an account of another Thirty Years' War."

This first volume is broken down into two books respectively labelled "From War to War" and "The Twilight War." With appendices it runs over 780 pages. Truly a monumental thing.

The moral of the work is typically Churchillian:

In War: Resolution
In Defeat: Defiance
In Victory: Magnanimity
In Peace: Good Will

The stated theme of the volume is an indictment in which we all must share:

"How the English-speaking peoples through their unwisdom, carelessness, and good nature allowed the wicked to rearm."

"The Gathering Storm" is bristling with excerpts from Churchill's speeches, letters and writings, items which serve as a documentation of his statesmanship and of his consistent and unerring calling of the turn. He is unsparing of self-criticism, quick to assume a full measure of responsibility, and most kind with his opponents, most of whom fare badly enough in the documentation and in the light of events, despite his benevolence. Churchill on Chamberlain may well go far to redeeming the latter in the eyes of many who adopted casual, hasty judgments without a full knowledge of background. Therein lies much of the value of history.—*Cavalry Journal.*

ON ACTIVE SERVICE, by Henry L. Stimson. 672 pages. Harper & Bros. $5.00.

THIS BOOK by one of the greatest of modern American patriots and public servants will be reviewed in the next issue of SIGNALS. Robert E. Sherwood terms it "the true beginning of the verdict of history" and the New York Post says "Few memoirs with the possible exception of Winston Churchill's can shed as much light on World War II."

APPOINTMENT ON THE HILL, by Dorothy Detzer. 262 pages. Henry Holt. $3.00.

THIS IS A well-written record of twenty futile years during which Miss Detzer served as lobbyist in Washington for the Women's International League for Peace and Freedom. It is also a revealing account of the inner workings of the peace lobby on Capitol Hill. A clammy kind of a business it is where pacifists have full sway but representatives of American industry, per se, are considered to be culprits!

Miss Detzer proudly claims a large share of the responsibility for the infamous Nye-Vandenberg Senate investigation of the munitions industry, 1934-1937. In fact she even claims that she selected the committee's chief investigator, Stephen Rausenbusch!

Former Secretary of State Hull has expressed doubt that any Congressional Committee has had a more unfortunate effect on our foreign relations. Indeed, students of our national defense hesitate to estimate the damage done to our country by that smear campaign —so great was the loss of men in battle as a result of our unpreparedness. And to this latter woeful state, Miss Detzer, Nye, Rausenbusch, Hiss, et al., made major contributions by reason of the infamous tactics and the horseplay in which the committee indulged.

Miss Detzer's book sheds light on the ay the pacifists get things done. She eems to be proud of the achievement —which, of course, is her right. The wo decades of which she writes are a retty sorry chronicle as far as peace nd freedom are concerned, and if she ols that she advanced the cause of ne peace one iota—that, too, is a feel- g no one can deny her, but to which ny will contest her title.—*Ordnance.*

ADAR, by Orrin E. Dunlap. 246 pages. Harper & Bros. $3.00.

RADAR—what it is and how it works —by Orrin E. Dunlap, Jr., is the irst popularly written story of this new iracle of radio science.

Mr. Dunlap, a veteran of wireless, ormerly radio editor of The New York Times, and at present chairman of AFCA's Advisory committee on Pub- icity, has added "Radar" to a list of en radio books which he has written n language the layman can under- tand. The story of radar is presented as a most fascinating and amazing nar- rative of science. The author traces the history of radar—the art of radio detec- tion and ranging—from the early re- flected wave experiments of Hertz and Marconi right up through the applica- tion of the radio "echo" to push-button warfare. He then looks ahead to radar's bright future in peacetime applications.

"Radar is detecting and ranging by radio," explains Mr. Dunlap. "Ra—radio; d—detection or direction-find- ing; a—and; r—ranging. There you have the make-up of the word r-a-d-a-r.

"When a radio pulse projected into space strikes an object in its path it returns as an echo within a fraction of a second, thereby detecting the pres- ence of objects, determining their di- rection and range, also identifying their character, whether ship or submarine, airplane or blimp, island or buoy. . . ."

The miraculous story of wartime ra- dar blends into radar in peace, with its great outlook as a new industry. The magic learned in war will be applied widely to peacetime pursuits, in the fields of transportation and navigation —the pilothouse and in the control tow- er; in weather forecasting, mapping and guiding the blind. Against its brilliant past, the future of radar sparkles with opportunity for young men and women with an aptitude for science. For those who would learn about radar, Mr. Dun- lap has compiled a glossary of terms, and has tabulated one of the most com- plete bibliographies of the subject ever assembled.

Profusely illustrated with pictures and simple sketches that help to ex- plain radar, the book is a contribution to the library of science that will long be valuable as a historic record of radar in the war. Dramatically, he makes radar easy to understand by all who read to learn and to be informed while being entertained. "Radar" is a story of man's ingenuity that puts Jules Verne in the background of fantasy. The end of the war lifted the curtain of secrecy on radar—a drama of sci- ence everyone will want to read about between the covers of this latest book, written by the same author who wrote the biography of Marconi, "The Future of Television," and "Radio's 100 Men of Science."

WHAT ELECTRONICS DOES, by Vin Zeluff and John Markus. 306 pages, illustrations. McGraw-Hill. $3.00.

ELECTRONICS has become a common word since it was first chosen as the title of a periodical in 1930. The applications of electronics have multi- plied to such an extent that the present book contains a selection of over four hundred examples.

The text is divided into nineteen chapters which present the subject from various viewpoints. Different types of electronic phenomena are presented in the first five chapters—electrostatics, dielectric heating, induction heating, ultrasonics, and electronic viewers and phototubes. Then follow chapters on the use of electronics in particular media—in the air, on water, on land and underground. Specific functions that electronics may perform are also considered, such as inspection, produc- tion control, measuring, and counting.

The many uses of electronics range from those with which the average in- dividual may come in contact, such as traffic controls, diathermy equipment, or safety devices on machinery, to the unusual application seen only by a few —a device for tracking schools of fish. Directly or indirectly nearly all the uses detailed in this book contribute in some way to increased efficiency or height- ened production. Electronics has also made possible the accomplishment of many tasks hitherto thought impossible.

Written in a readable style with many illustrations, this book will be of inter- est to those who wish to learn about the wonders of electronics. Read care- fully, it may suggest applications of electronics suitable to the reader's own business.—*Franklin Institute.*

THEORY AND APPLICATION OF MICROWAVES, by A. B. Bronwell, Northwestern University, and R. E. Beam, Northwestern University. Mc- Graw-Hill. 470 pages. $6.00.

THIS IS A text or reference book de- voted to the fundamental theory of microwaves and their application to communications. It treats transmission line equations, the use of impedance diagrams in solving transmission line problems, and transmission line net- works. The various chapters deal with the propagation and reflection of plane waves, solution of the wave equations, wave propagation, oscillations of cavity resonators, radiation from antennas, and directional radiating systems. Care- fully selected problems are included which, together with the excellent ar- rangement and selection of the materi- al, make this book an excellent text book for communication courses.

TECHNIQUES IN EXPERIMENTAL ELECTRONICS, by C. H. Bachman. 252 pages, illustrations. John Wiley & Sons, Inc. $3.50.

ELECTRONICS, as discussed in this book, is defined as "that brand of science and technology which relates to the conduction of electricity through gases or in vacuo."

Starting with the description of the necessary apparatus, the book proceeds to the active production and measure- ment of vacua, instructs in the glass blowing fundamentals such as tabula- tion, glass seals, preparation of elec- trodes, etc., and also discusses the sources, control, and utilization of charged particles. There is also a chap- ter on the assembly and processing of electronic devices.

The author covers the basic tech- niques employed in electronics research and his book should prove valuable to physicists, electrical engineers, and oth- ers about to tackle research in this field.—*Franklin Institute.*

RADIO AT ULTRA-HIGH FREQUEN- CIES, Volume II (1940-1947), RCA Review, RCA Laboratories Division. 480 pages. $2.50.

THIS VOLUME constitutes an extensive collection of technical papers writ- ten by RCA scientists and engineers covering the principal research devel- opments during the years of 1940 through 1947 in the field of the higher radio frequencies. It should prove in- valuable to those concerned with the technical aspects of ultra-high-frequen- cy radio.

In the interest of continuity and sim- plicity, the editors have taken some liberties with the concept of the ultra- high-frequency band. As a result this volume constitutes a broader coverage of developments in the frequencies above 30 megacycles than the title may imply.

"Radio At Ultra-High Frequencies," Volume I, has met with such wide ac- ceptance as a valuable reference book that the supply has been exhausted for some time. This second volume will un- doubtedly prove to be of equal value and of wide interest since the future of radio and electronics must, of necessity, lie in the higher-frequency portion of the spectrum.

ULTRA-HIGH-FREQUENCY RADIO ENGINEERING, by Willis L. Emery. 295 pages. The Macmillan Company. $3.75.

A THOROUGHLY understandable presentation of the theory is given in this text, which completely covers the outline adopted for short courses at the Electronic Teachers' Conference at M.I.T., held at the beginning of the war. Derivations have been made as direct as possible. Solved problems illustrate the application of theory.

AERIAL PHOTOGRAPHS IN FORESTRY, by Stephen H. Spurr. 340 pages. The Ronald Press Company. $6.00.

THE TITLE of this book does injustice to its coverage of photography, for though it is an excellent dissertation on the application of aerial photography to forest mapping and tree measurement it is more than that. The book contains much of interest on aerial photography, especially in the use of continuous strip film.

AIR VICTORY, The Men and the Machines, by Harold B. Hinton. 428 pages. Harper & Brothers. $5.00.

AIR VICTORY is well titled. This history of United States military aviation is not only the story of the phenomenal growth of the U. S. air arm from a fourth rate prewar power to the victorious, world's most powerful, during the space of the war, but is a recital of the victory of the airminded over early inertia, prejudice, short funds, and ignorance.

From the Wrights' first flight Mr. Hinton traces step by step the gradual development of this country's military aviation, in all its facets, and it makes fascinating reading—remarkably so for a factual history. As the author says in his opening, the story is that of the period from Kitty Hawk to Hiroshima.

The index in the back of the book indicates the scope of the book's coverage. There seems to be scarcely a name of man or place omitted which has figured in the birth and growth of the U. S. Air Force. The preparatory research on the book has obviously been lengthy and intense.

Mr. Hinton is exceptionally qualified to write a history of United States air power. He has impressive background in newspaper work, and with the Army Air Corps in both World Wars. His writing career spans a long period with the New York *Times* during which, from 1923 to 1932 he had assignments in Paris and London, and later covered Pan American conferences in several Latin American countries.

In World War I he served as a pilot in the 213th Squadron, 3rd Pursuit Group. He was recalled to active duty as a major in 1941 and served at General Eisenhower's London HQ in 1942. From there he returned to the United States to enter the Command and General Staff School. Upon graduation from the school he was promoted to lieutenant colonel and assigned to the Twelfth Air Force in North Africa. Moving with the Twelfth to Italy he was there designated Assistant Chief of Staff, A-2, and promoted to full colonel.

FUNDAMENTAL ELECTRONICS AND VACUUM TUBES, by Arthur L. Albert. 422 pages. The Macmillan Company. $5.00.

PROVIDING a sound foundation in electronic theory and its principal applications in both the communications and power fields, this text explains all underlying theory fully and clearly, and gives illustrative applications at the end of the discussion of each step in theory. Attention is called to the following points: the presentation of underlying electronic theory at the start so that the applications may be better understood; the excellent balance between tube description and theory and circuits and application; the simplicity and thoroughness of treatment; the avoidance of either too simple or too complex mathematics.

ONE STORY OF RADAR, by A. P. Rowe, C.B.E. 208 pages. The University Press. $2.50.

THE MEN in Britain who worked on radar just before the war were men with mission and the story told here reveals the excitement of the work, the elations and depressions as it progressed or faltered, and the pride in achievement. As the title is meant to show, this is not the full story of radar, but one story, and a personal one.

Mr. Rowe, who was with the Telecommunications Research Establishment from the beginning, and was its wartime chief superintendent, tells from within how radar for the Royal Air Force developed there. His theme is the creation of close understanding and informal yet constant cooperation between Service user and scientist inventor, a cooperation which was one of the greatest British assets, and which precisely was not possible within the German militarist tradition.

PRINCIPLES OF ELECTRONICS, by Royce G. Kloeffler. 175 pages. John Wiley & Sons, Inc. $2.75.

BEGINNING with the discovery of the electron and the forces of attraction and repulsion of charged particles, the entire action taking place in electronic devises is carefully explained in an unusually clear manner.

ELEMENTARY PHOTOGRAPHY, by C. B. Neblette, F. W. Brehm, E. L. Priest. 295 pages. The Macmillan Company. $2.00.

THIS PRACTICAL BOOK explains the construction and operating principles of cameras in simple, graphic terms, and gives full, practical directions, with illustrations, for making, developing and printing successful pictures. Night pictures, action pictures, portraits, color and microscopic photography are all covered, with much useful information on film, lenses, printing methods, etc.

VACUUM TUBE CIRCUITS, by Lawrence Baker Arguimbau. 668 pages. John Wiley & Sons, Inc. $6.00.

THE VAST AMOUNT of information on this phase of communications has been compressed and edited, so that topics of major importance receive the most thorough attention. More emphasis is given to frequency modulation as opposed to amplitude modulation; more of the basic material on transient response and on the generation of microwaves is covered, in view of rapid developments in the field of television.

INSIGNIA OF THE ASSOCIATION

ORDERS are now being received for delivery for the Association Insignia in full colors suitable for framing as mentioned in May SIGNALS. The cost of the emblem, 5¾" in diameter on 8 x 10 white background, will be $1.50. Order now to help us determine the number of copies we need to purchase.

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